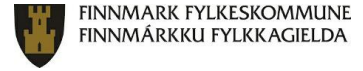


## AN ARCTIC RAILWAY VISION

*The goods perspective for an Arctic railway between  
Rovaniemi and Kirkenes linking to a port on the Barents Sea*





*Front page:  
Illustration from video produced in 2014 for the Arctic Corridor project  
by Region of Northern Lapland - <http://arcticcorridor.fi>*

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## Perspectives for an Arctic railway: The Vision

**The vision for The Arctic Railway is to be able to offer an environmentally-friendly and faster transport alternative for goods between Northeast Asia and Northern Europe via Finland by utilisation of the Northern Sea Route (NSR) and development of Kirkenes as a hub port.**

- As the first Western port on the route, Kirkenes would be a strategic hub in the north for liner traffic transporting containers to and from Asia
- The transport time through the Northern Sea Route is the fastest route from China with a railway link to Northern Europe via Kirkenes
- As the first Western port in the north with a railway link, Kirkenes would experience major employment effects in addition to wider economic effects in East Finnmark

This rail vision is based on the shortest travel time for containers from China to Northern Europe, and that the Port of Kirkenes would be the triggering factor for a railway line in a 2040 perspective. This route has the potential to be a new “maritime silk route in the north”.

### The basis for this vision

This vision is based on 10% of the current combined international container trade from China, Taiwan, South Korea and Japan to the North European countries Germany, Denmark, Finland, Sweden and Norway using the Northern Sea Route (NSR) combined with transloading to a rail link in Kirkenes. This vision is based on container ships transporting 4,800 TEU (containers).

### 10% of the container traffic provides huge possibilities!

The basis of the vision whereby 10% of the current volume of goods is transported on this railway line would offer the following possibilities for the Port of Kirkenes with a rail link to Finland continuing to Scandinavia, the Baltic countries and Western Europe:

- **10 southbound goods trains per day from Kirkenes to Finland and on to other destinations**
- **550,000 containers transloaded per year** – or 37,000 containers per month – from Asia via the Port of Kirkenes during a 7.4-month navigation season, as well as the same number of containers (empty or with export cargo) on the return leg from Europe
- **400-600 people** could gain direct employment in Kirkenes. Based on a 7.4-month navigation season on the NSR, a terminal port in Kirkenes must have equivalent or greater capacity than the Port of Gothenburg.
- **The container traffic between Asia and Europe will be almost threefold in 2040**, so even a share of 3-4% of the combined container imports from China, Taiwan, South Korea and Japan to Northern Europe would generate comprehensive activity at the Port of Kirkenes and on an Arctic railway to Rovaniemi.
- **A 40% reduction of the sailing distance via the Northern Sea Route (NSR)** compared to the current route through the Suez Canal between the northern part of Northern Europe (from Germany and northwards) and the Asian countries of China, Taiwan, South Korea and Japan
- **A 20% reduction in fuel consumption** compared to the route through the Suez Canal would generate climate effects.

### The potential for goods transport linked to Russia, the Baltic countries and Poland

An Arctic railway could also offer faster freight transport through direct access via Helsinki to the three Baltic countries and Poland, as well as to St. Petersburg in Russia.

- A reduction of 2-5 days through loading goods onto a train in Kirkenes compared to shipping via the NSR – the Baltic Sea

- 10% of the current flow of goods from China to the Baltic countries and Poland via Kirkenes could amount to an additional 37,000 TEU per year on an Arctic railway.
- The transportation of frozen fish and general cargo in containers from the far east of Russia to St. Petersburg and vice versa provide a significant cargo basis for an Arctic railway.

### **Other possibilities linked to tourism and commercial transport**

There are no triggering factors, but rather secondary opportunities for a railway

- Tourism and the transportation of tourists between Rovaniemi and Kirkenes
- The potential for future exports from the Finnish mineral industry
- Export of seafood and white fish

### **Reduced transport time compared with the Suez Canal**

Chinese calculations show that a container liner with a capacity of 4,800 TEU, low ice class and a 7.4-month navigation season via the NSR could be economically competitive with the Suez Canal.

This includes a significant time saving:

- a. The sailing distance Shanghai – Hamburg via the Suez Canal is 12,277 nautical miles. At an average speed of 13 knots, it takes 39 days to complete this distance.
- b. The sailing distance Shanghai – Kirkenes via the NSR is 6,517 nautical miles. At an average speed of 13 knots, it takes 21 days to navigate this distance.
- c. The travel time on an Arctic railway Kirkenes – Hamburg via the new Helsinki –Tallinn railway tunnel would be roughly two days, and would also contribute to significantly faster to the growing markets of Estonia, Latvia, Lithuania and Poland, which are en route.
- d. In principle, the current railway network between China and Europe via Russia makes possible a transportation time of 15 days between Shanghai and Hamburg. However, there are large bottlenecks on the Russian railway network due to busy traffic, particularly in the east of the country. A comprehensive movement of Chinese cargo to Europe from ship to rail would maintain or boost this problem even if the railway network is expanded.<sup>1</sup>

### **Assumptions in a strategic perspective of 2040**

This vision has a perspective of 2040, and is based on the following factors being realized:

- Climatic conditions linked to opening the Northern Sea Route beyond the current 6-7 months, and that the activity at the Port of Kirkenes is on an annual basis
- Political and commercial agreement concerning the use of the route and that emergency preparedness and security is satisfactory
- Financing and investment costs for the construction of a port in Kirkenes and a railway line to Rovaniemi
- The Norwegian Government has started the planning of a new large scale “Barents Harbor” in Kirkenes. This new harbor in Kirkenes, with all the complementary functions and assets, must be developed to serve the both the short and long-term logistic opportunities in the Barents Region in order to serve the purpose of the Arctic Railroad vision
- Construction of a railway tunnel to the Baltic region will be a decisive factor to achieve the efficient transportation of goods to Germany. If the tunnel is not constructed, 60% of the goods to Scandinavia would amount to the same trigger volume.

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<sup>1</sup> Challenges related to the Russian railway network are not described in this document, but are described in detail in Rautio/Bambulyak (2015) - *Drivers for increased use of the Northern Sea Route. Russian mining industry status and prospects.*

*This vision document results from work initiated in collaboration by Sør-Varanger Utvikling AS, Kirkenes Næringsshage AS and Finnmark County Council in the autumn of 2017. The background was an initiative from the Finnish Minister of Transport and Communications, Anne Berner, in May of the same year, of the wish to take a closer look at the possibility of building a 550 km Arctic railway from Rovaniemi to Kirkenes. This was endorsed in October of the same year by the Norwegian Minister of Transport and Communications, Ketil Solvik-Olsen, who instructed the Norwegian National Railway Administration to work on this in collaboration with the Finnish Transport Agency.*

### **Concluding remarks**

As the attention and progress around the different railroad solutions increases, we also notice that there are elements that have not been handled in our “vision document”, and that the content of this document might be too comprehensive to engage parts of the general public. Due to this, we have made some clarifications.

It has been said that The Norden Sea Route (NSR) is too shallow, making this fairway uneconomical for container shipping. However, studies done at Jiao Tong University in Shanghai illustrate models where vessels carrying 4800 TEU on NSR can compete with vessels carrying 15 000 TEU through the Suez Canal. You will find more about this in on p.20-22 in the vision report.

Another important aspect is that The Ministry of Transport and Communications has decided to study the possibilities of establishing a strategic port within the “Norwegian core network” in Kirkenes. The study is handled by The Norwegian Public Roads Administration (NPPRA) (Statens Vegvesen). NPPRA started their work in the summer of 2017, and is planned to be finished within the autumn of 2018. The NPPRA is engaging relevant consultancy companies right now, and they are connecting the road E6 and including a railroad terminal into their planning work. Several national companies have shown interest in use and development of the port.

The vision document has not emphasized that Finnish Lapland experience a rapid growing interest from Chinese business actors. This growing interest is especially tailored towards the energy- and tourist industry. In addition, the Finns are planning to open a direct flight between Beijing and Rovaniemi during the spring of 2019. As an example of the growing interest in Lapland, the Arctic Business Yearbook 2017 – produced by the Lapland Chamber of Commerce and Industry, expect the Chinese actors to invest more than 2 billion NOK (about 220 million USD) in their region during the next five years.

Lastly, we were informed that a consultancy company argues that the NSR is unfeasible for container shipping due to low temperatures in the fairway. After contacting one of the leading shipping companies in Norway, with strong international networks and partners, can we ensure that there is no evidence or reason to claim this. Shipping along cold areas has been done around the world for quite a long period. The shipping companies know how to handle this professionally, and they use thermos containers for the relevant cargo. In addition, it is important to highlight that the shipping company explains that a total of 5% of the freight demands thermo solutions (cold and warm), and if this becomes a major problem at the NRS they will find other ways for this particular freight.

Altogether, the railroad and the longtail effects and spin-offs will enable our region to handle a sustainable, innovative and effective future. Therefore, if our decision makers to look into the future - and really want to have a leading hand on the development of Arctic - our vision document clearly illustrates the possibilities of connecting Asia and Europe through Kirkenes and Finland.

## Basis for the vision

### The Northern Sea Route (NSR)

The NSR represents a significant reduction of the sailing distance between Southeast Asia and Europe compared to the current traffic through the Suez Canal. This route would be particularly favourable between the northern part of Northern Europe (from Germany and northwards) and the Asian countries China, South Korea and Japan, and can reduce the travel time by around 40% and the fuel consumption by 20%.

### Russia and China's view of the NSR

As the dominant economic superpower and trading nation, China has shown a steadily increasing interest in the development in the Arctic. To date, much of this has been connected to research, but China has also invested heavily in Russian industrial and logistics projects in Western Siberia and the Arctic part of European Russia.

### China and maritime container traffic

Seven of the world's largest container ports measured on throughput are in China. In 2015, these ports handled a total of 150 million containers. If one works on the basis that, as an alternative container route between Asia and Europe, the NSR could have greatest economic significance on stretches that offer a major difference in sailing distance and sailing time compared to using the Suez Canal. Consequently, ports along the coast of Germany and northwards are of primary interest in an assessment of the potential flow of goods through the NSR via Kirkenes.

### Container ships through the NSR

Russia and China both wish to utilise the NSR for container cargo based on new ship designs. In 2015, the Federal Agency for Maritime and River Transport in Russia (RosMorRechFlot) approved a concept for an ice-strengthened container ship with a capacity of 3,000 standard containers developed by the Ukrainian Marine Engineering Bureau. In the same year, Jiang Nan Shipyard in Shanghai carried out a feasibility study of Arc-class container ships, and developed a design that can transport 4,000 containers along the NSR.

The work is continuing, and the ongoing efforts will involve several test sailings via the NSR and through the Suez Canal, but individual calculations show, for instance, that the cargo costs for 4,800 containers via NSR is comparable with 15,000 containers via the Suez Canal if the navigation season via the NSR is extended to 222 days (7.4 months).

Beijing Transport Research Institute is also working on a model for good transport on the NSR. The profitability of this model is reliant on factors such as the availability of accurate ice forecasts for the NSR, enabling the most efficient utilisation of the navigation season. Consequently, China is lobbying for the financing and construction of meteorological stations in the European Arctic.

However, with rising temperatures in the Arctic, less ice and increasingly longer navigation seasons on the NSR, the use of smaller conventional container ships on this route is being assessed. Researchers at Jiao Tong University in Shanghai are currently working on two complex models for comparative scenarios to calculate the profitability of container transport on the NSR vs Suez. This involves the use of container ships with a capacity of 4,800 containers with a low ice class via the NSR and varying vessel sizes via Suez, which is also based on variations in the length of the navigation season via the NSR, variations in the price of fuel and the need for icebreaking assistance, etc.



### **Container cargo between China and the northern part of Northern Europe via the NSR**

Hamburg is the largest European port for Chinese goods. In 2016, 11 million tonnes and 1.55 million containers from China (including Hong Kong) were imported here, while the equivalent exports were 8 million tonnes and 996,000 containers. By way of comparison, the combined turnover per international traffic at all Norwegian ports from China in 2016 was 617,000 containers.

Based on a unit conversion factor of 9,2 tonnes of goods per container, we have estimated that the combined imports by container in 2016 from China to Germany, Finland, Sweden, Denmark and Norway – which in terms of distance have a favourable location to the NSR – were 2.26 million units. This equates to 6,200 twenty-foot equivalent units (TEU) per day.

If 10% of China's export to Germany, Finland, Sweden, Denmark and Norway in 2016 was shipped via the NSR to the Port of Kirkenes for transloading to southbound rail transportation, this would constitute 1,018 containers per day – or a vessel with 4,800 containers every fifth day – within a 222-day sailing window. This would require eight south-bound trains per day to keep pace with the unloading.

Empty containers and export cargo would also be returned to China to maintain the directional balance. This traffic alone would generate around 16 freight trains carrying 1,900 – 2,000 containers per day through the Port of Kirkenes and on the stretch Kirkenes – Rovaniemi for a period of 7-8 months per year.

### **Container cargo between other Asian countries and the northern part of Northern Europe via the NSR**

If one also adds the combined imports from the three Southeast Asian countries Taiwan, South Korea and Japan, which in 2016 totalled 4.2 million tonnes, this provides an additional volume of 424,000 tonnes – or 20% of the Chinese cargo volume. This converts to 46,087 containers via the NSR to Kirkenes, or one transport ship every third week during the shipping season.

The combined cargo from South Korea, Japan and Taiwan via the NSR to Kirkenes would generate 9.6 calls. This means a call every third week in addition to the container traffic from China. This traffic has the potential to increase through extended navigation seasons owing to rising temperatures in the Arctic, and as the maritime container traffic between Asia and Europe is growing by 4-5% per year.

By making use of the new Baltic railway to Germany, it would also be possible to achieve significant time savings in the transportation of goods to and from the growing markets of Estonia, Latvia, Lithuania and Poland. Based on the current figures, 10% of the combined imports to this market from China via NSR would constitute 37,000 containers or one freight train every day during the navigation season.

### **Other markets**

There is potential for further growth in cargo traffic growth via the Port of Kirkenes and an Arctic railway via the NSR from other Asian trading partners, other parts of Northern Europe and to/from ports on the east coast of USA and Canada.

### **The NSR for Russian container cargo**

The NSR also represents a potential for liner traffic of Russian fish in freezer containers from the far east of Russia to Murmansk and St. Petersburg. There is the potential for 137,000 containers per

season or one sailing every second week. Such liner traffic can represent a cargo basis between the ports of Murmansk and Kirkenes.

### **The NSR as a prerequisite for an Arctic railway with Kirkenes as the hub**

An Arctic railway from Rovaniemi to Kirkenes with a hub port on the Barents Sea would be reliant on liner traffic with containers to and from Asia through the Northern Sea Route (NSR) to generate a regular and sufficient flow of goods for a high proportion of the year.

Based on current figures, 10% of the combined exports by container from China, Taiwan, South Korea and Japan to the northern European countries of Germany, Denmark, Finland, Sweden and Norway would constitute 275,000 containers per year. This could generate more than 37,000 containers per month via the Port of Kirkenes during the 7.4 month-long navigation season. This would in turn generate 296 southbound goods trains with a length of 750 m per month – or approximately 10 such trains per day.

During a 7.4 month-long navigation season along the NSR, a terminal port in Kirkenes must have equivalent or greater capacity than the Port of Gothenburg. It could directly employ 600 or more people.

This vision document is based on 10% of the goods volume and container traffic between the countries concerned in 2016. However, with an expectation of strong growth in the container traffic between Southeast Asia and Europe, the suggested volume via the NSR would constitute just 3-4% of the combined container trade in 2040.

### **The basis for an Arctic railway**

If an Arctic railway is going to be economically sustainable, it must have traffic that provides year-round activity at the railway line's hub. Beyond the traffic via the NSR, which would be a cornerstone of the operation, there would be a need for other traffic in the period the NSR is closed to traffic.

In the longer term, the mining, timber and bio industries in Finnish Lapland may form an important element for year-round operation of an Arctic railway. The mineral potential is significant, while extensive development work with the production of biofuels is also underway.

In Finnmark County, the transport of farmed salmon and fish from the Barents Sea also represents a potential. The annual production of farmed salmon currently equates to 3,420 articulated lorries – or about 40 complete trains. The central freezer warehouse in Kirkenes receives between 14,000 and 18,000 tonnes of frozen fish annually, which equates to between 1,522 and 1,956 containers – or 10-15 complete trains. However, the potential for transport on the railway line is significantly greater, as a total of 131,000 tonnes of fish were landed in Finnmark County in 2016.

Furthermore, 50,000 tonnes of waste are transported annually by road from Finnmark County to Southern Norway or Sweden for processing. This amounts to 4,100 - 4,200 tonnes per month, which can be converted into around three complete train.

In 2017, the tourism industry in Finnish Lapland had 2.3 million guest nights, of which 1 million were foreign nationals. By the end of October 2017, the tourism industry in Finnmark County had 611,000 guest nights, of which 242,000 were foreign nationals.

### **The significance for the development of the Port of Kirkenes**

A conservative estimate of goods, which includes return cargo for directional balance, shows that the Port of Kirkenes could receive an annual throughput of 550,000 containers linked to traffic via the NSR.

This is nearly three times the throughput at the Port of Oslo, which is Norway's largest container port with 207,000 units in 2016. However, the volume amounts to 70% of the container traffic at the Port of Gothenburg, which is Scandinavia's largest port.

For Kirkenes, we are talking about a container season of about 7.5 months, which gives a throughput of 74,000 containers per month. In comparison, the two other ports operate year-round and have an average monthly throughput of 17,250 containers (Oslo) and 66,500 containers (Gothenburg).

One can gain an indication of the scope by looking at the organisation of the ports of Oslo and Gothenburg. The Port of Oslo serves as a landlord and has an administration numbering around 100 employees. These cover staff functions and four departments: traffic, property, technical and urban development. The port functions as a landlord for all commercial activities in the port: terminals, railways, shipping agents, etc. Gothenburg port is organised in a similar manner, with 120 employees in the administration.

Neither Oslo nor Gothenburg may be compared directly with Kirkenes as both are also major cruise and passenger ports with almost 6 million travellers per year, and both offer a broad range of services. An economic impact report of the Port of Oslo indicates that it generates 3,000 jobs. However, we have comparable figures from the operation of Møller-Maersk's APM Terminals at the Port of Gothenburg, which handles the container traffic there. The terminal has 440 employees, serving three container ships at the port daily and loading/unloading an average of more than 2,328 containers. They also load/unload 14 trains with 890 containers, in addition to 1,664 containers arriving/departing by articulated lorry.

For Kirkenes, port activity on such a scale would be significantly larger than the mining activity in the town up to the end of 2015, measured in terms of both direct employment and social impact.

### **Stricter environmental requirements for shipping in the Arctic**

Requirements relating to the ban on heavy fuel oils in the Arctic will have an impact on shipping via the NSR. However, such fuel regulations currently applicable already have a major significance on shipping in the Baltic Sea and North Sea, forcing modifications and eventually other mechanical and fuel solutions for new ships. As such, it will not specifically affect future traffic on the NSR, but rather suggests that in the future all global shipping will have a stronger environmental profile.

### **The NSR vs the Suez Canal**

The current low fuel prices and increased capacity on the Suez Canal have contributed to reducing the maritime industry's interest in the NSR. However, these conditions may change through improved conditions, e.g. rising fuel prices, better emergency preparedness and a longer navigation season owing to climate change which has led to thinner ice and a longer ice-free season.

### **A warmer Arctic**

A warmer Arctic can create more favourable conditions for shipping by keeping the entire NSR open for an extended season and perhaps it may be ice-free as early as 2030. However, rising temperatures in the Arctic may lead to unfavourable developments such as significantly more drift

ice and more unstable and volatile weather conditions, which combine to making the route more challenging to navigate.

## 0 SUMMARY

An Arctic railway from Rovaniemi to Kirkenes with a hub port on the Barents Sea would be reliant on liner traffic with containers to and from Asia through the Northern Sea Route (NSR) to generate a regular and sufficient flow of goods for a high proportion of the year.

### **10-11 southbound trains per day**

With the correct dimensioning of the railway line and port, a conservative calculation shows that 10% of the combined exports by container from China, Taiwan, South Korea and Japan to the northern European countries of Germany, Denmark, Finland, Sweden and Norway would constitute 275,000 TEU<sup>2</sup> per year. This could generate more than 37,000 containers per month via the Port of Kirkenes during the 7.4 month-long navigation season. This would in turn generate 296 southbound goods trains with a length of 750 m per month – or approximately 10 such trains per day.

Adding China's trade with the Baltic countries and Poland and using the same calculation would give a further 37,000 TEU in the navigation season on the NSR – or roughly one additional southbound train per day.

### **Directional balance**

To achieve a balanced liner traffic, one must work on the basis that the same number of TEU (either empty or loaded with cargo) must be returned in the opposite direction, meaning that the throughput at the port would be approximately 85,000 TEU per month and increase to approximately 20-22 trains per day, depending on how the loading and unloading is organised.

### **Local activity on a par with Gothenburg**

It is worth noting that we are talking about a combined volume of goods which, on an annual basis, would be nearly three times greater than the current number of TEU at the Port of Oslo, and at least 70% of the container traffic at the Port of Gothenburg, which is Scandinavia's largest port. Within a 7.4-month navigation season on the NSR, a terminal port in Kirkenes must have equivalent or greater capacity than the Port of Gothenburg. This could provide direct employment for 600 or more people.

### **Strong growth in container cargo towards 2040**

If the estimated volume of goods from Asia via the NSR remains at the same level in the years ahead, it will in time amount to just 3-5% of the combined maritime container cargo from and to the selected countries given that this cargo is expected to increase by 60% in Europe by 2030 and by a further 70% between 2030 and 2040.

*This means that in the future, even a share of 3-4% of the combined container imports from China, Taiwan, South Korea and Japan to Northern Europe would generate comprehensive activity at the Port of Kirkenes and on an Arctic railway to Rovaniemi.*

### **Challenge with the NSR**

The primary challenge with such a development concept is that the NSR cannot be navigated year-round. China currently works on the basis that a navigation window of 7.4 months is realistic and – and within given scopes – profitable by using container ships with a low ice class and a capacity of

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<sup>2</sup> Twenty-foot equivalent unit (TEU) is an international standard for containers. Most containers are standard 40-foot containers, which count as two TEU.

4,800 TEU. However, this can mean 4.5 months without goods via the NSR, which would give low activity in the period January - March for a port with large capacity and many employees.

### **Climate change**

Rising temperatures in the Arctic could increase the navigation seasons on the NSR in the direction of year-round as prognoses indicate the NSR may be ice-free as early as 2030. However, this may create new challenges associated with more drift ice and more unstable and volatile weather conditions, but from a goods perspective could solve the challenges associated with dealing with a low season at a hub port in Kirkenes and on an Arctic railway from there to Rovaniemi.

### **Local and regional cargo basis**

Locally and regionally, there is currently a relatively weak cargo basis for an Arctic railway. However, the future possibility of new mines in Finnish Lapland could contribute to dry bulk being an important year-round activity along an Arctic railway and via the Port of Kirkenes. Interesting developments are also taking place concerning the production of biofuels in Kemi and Kemijärvi.

On Norwegian side, fresh and frozen fish from the Barents Sea may also represent a positive contribution to a railway through both Russian and Norwegian direct landings in Kirkenes and road transport from fish processing plants and freezing facilities along the coast of East Finnmark. However, fresh salmon is not considered relevant as the processing plants are mostly in West Finnmark or further south. In terms of volume, time and price, transportation by road is optimal for the export of salmon to Europe. Consequently, transportation from the processing plants to the railway terminal in Kirkenes combined with later transloading from the train to a lorry would be both more expensive and take longer.

### **Intensifying environmental requirements for shipping**

From an environmental perspective, an IMO or unilateral EU ban on the use of heavy fuel oils on ships in Arctic – as is the case in Antarctica – could represent a challenge for traffic on the NSR. Similar processes are taking place in the Baltic Sea and the North Sea, so that in the long term such a ban will apply far beyond the NSR and, as such, force a general shift towards more environmentally-friendly shipping.

### **Unclear Russian attitude towards utilisation of the NSR**

The NSR currently plays an increasingly important role for Russian coastal traffic (destination traffic) related to industrial development, especially linked to oil and gas. However, Russia's attitude towards the NSR as an international transit route remains unclear. The security policy aspect is being assessed against commercial needs to generate revenue to help pay for Russia's major investments related to infrastructure and icebreaking services along the route.

## 1 INTRODUCTION

This vision document results from work initiated in collaboration by Sør-Varanger Utvikling AS, Kirkenes Næringshage AS and Finnmark County Council in the autumn of 2017. The background was an initiative from the Finnish Minister of Transport and Communications, Anne Berner, in May of the same year, of the wish to take a closer look at the possibility of building a 550 km Arctic railway from Rovaniemi to Kirkenes. This was endorsed in October of the same year by the Norwegian Minister of Transport and Communications, Ketil Solvik-Olsen, who instructed the Norwegian National Railway Administration to work on this in collaboration with the Finnish Transport Agency.

Through this Finnish-Norwegian government initiative, one will assess relevant routes and construction costs for alternative stretches in the direction Kirkenes, Murmansk and Tromsø, and this work should be completed by 28 February 2018.

Through the existing regional follow-up initiative, we wished to highlight the goods potential for an Arctic railway, both currently and in a time perspective up to 2040, which is the scope for the construction and completion of such a railway project. The perspective is local, regional and international, and considers the most relevant development characteristics related to international trade and logistics, as well as environmental perspectives, climate change and political conditions.

This vision document does not make a cost or profitability assessment related to an Arctic railway from Rovaniemi to the trans-shipment port in Kirkenes, nor any economic calculations or physical assessments of suitable routes for the line. This is partly because such information will form part of the assessment to be presented by Finnish transport authorities and the Norwegian National Railway Administration by the end of February 2018, and partly because this will naturally form part of a follow-up feasibility study or preliminary project.

This vision document has been compiled in cooperation with a project group consists of:

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2. Eirik Selmer, Senior Advisor Central Administration, Finnmark County Council
3. Arve Tannvik, Project Manager, Kirkenes Utvikling AS
4. Kjell Stokvik, CEO, Centre for High North Logistics
5. Bjørn Johansen, District Secretary, LO Finnmark and county councillor
6. Timo Lohi, Development Manager, Northern Lapland, Sodankylä

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- ✓ Arild Moe, Senior Research Fellow, Fridtjof Nansen Institute, Oslo

Kirkenes, 9 January 2018  
**KIRKENES NÆRINGSHAGE AS**

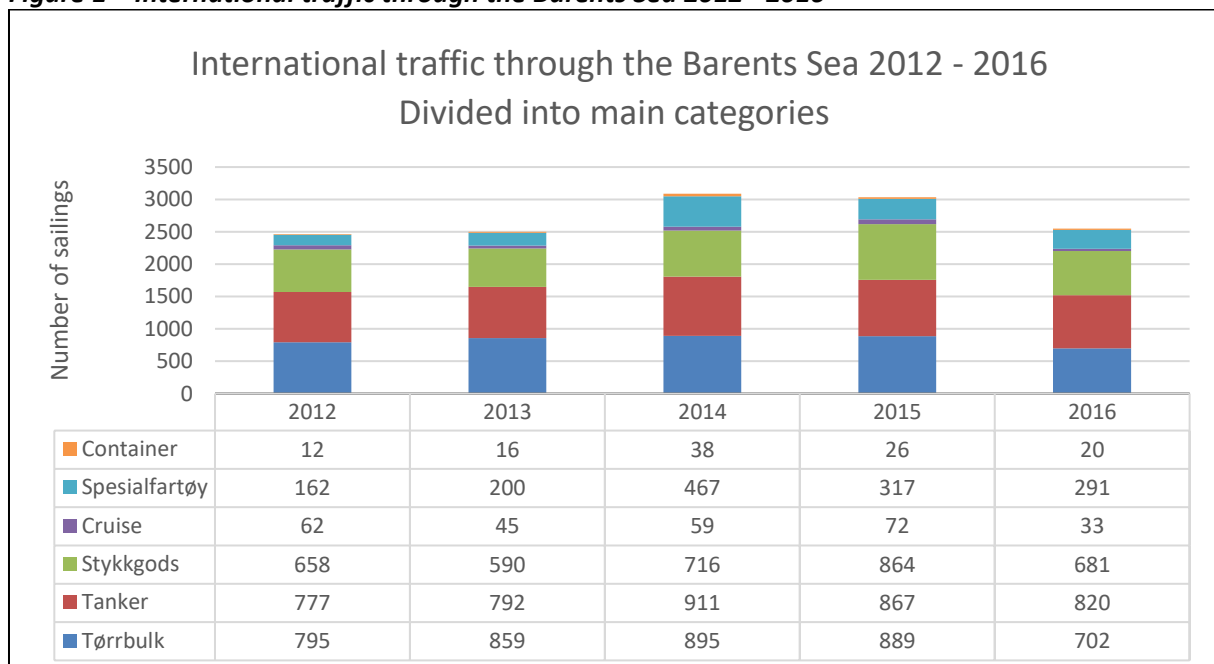
Rune Rautio  
Project Manager

## 2 CURRENT MARITIME GOODS TRAFFIC IN THE NORTH

In the period from 2012 to 2015, the Norwegian Coastal Administrations Vessel Traffic Centre North registered an increase from around 3,400 vessel movements through Norwegian and international waters between Tromsø and Northwest Russia to around 4,600 movements. This represents a growth of 35% during the four-year period. Of the movements in 2015, a total of 1,073 (23%) were between Norwegian ports in territorial waters. The remainder were transfers through the Barents Sea to/from Russia or traffic through international waters to/from Norwegian ports.

The combined traffic of dry bulk, general cargo, container, cruise og special vessels through international waters in the Barents Sea grew by 19% in the same period. However, in 2016 this amount fell by 16%, while the combined exports via the ports in Northern Russia increased by 6%, from 30 to 32 million tonnes. Exports from the Port of Murmansk increased by 25%, from 20 to 27 million tonnes. This grow occurred in all the port's volume segments.

**Figure 1 – International traffic through the Barents Sea 2012 - 2016**



Source: Akvaplan-niva AS

Spesialfartøy = Special vessels

Stykkgoods = General cargo

Tørrbulk = Dry bulk

### 2.1 Export

Among international goods traffic through the Barents Sea, there is a major dominance of exports of dry bulk and petroleum from Russian ports. There is also a volume of general cargo in the form of timber exports from ports on the White Sea.

In the years leading up to 2030, the export of natural resources from Arctic Russian ports will increase strongly as new oil and gas fields in the Pechora Sea, Yamalo-Nenets and on the Taymyr Peninsula enter production or reach full capacity.



The following oil and gas projects, which are based on export via the maritime route, are under development with full production anticipated by 2030:

**Table 1 – Russian Arctic petroleum terminals for sea transport under development up to 2030**

Name	Sea area	Oil company	Status
<b>Varandei</b>	Pechora Sea	Lukoil	In operation from June 2008
<b>Prirazlomnoye</b>	Pechora Sea	Gazprom Neft	In operation from December 2013
<b>Pechora LNG</b>	Barents Sea	Rosneft/Alltech	At planning stage
<b>Yamal LNG</b>	Kara Sea	Novatek	First operational phase 8 December 2017
<b>Novy Port</b>	Kara Sea, Ob River	Gazprom Neft	Year-round operation from winter 2015
<b>Arctic LNG</b>	Kara Sea	Novatek	At planning stage
<b>Tanalau</b>	Kara Sea, Yenisei River	IPC Group	At planning stage

Source: Akvaplan-niva AS

Overall, the most developed Russian terminal projects in the north represent an increase of up to 80 million tonnes per year in 2030 compared to 2016. The majority of this will be LNG.

The plan is that during the summer season much of the LNG will be transported eastwards along the NSR to China. However, overall most of the shipments from the new terminals will head westwards through the Barents Sea, mostly to Rotterdam in the Netherlands or Zeebrugge in Belgium (LNG).

Crude oil from Lukoil's terminal in Varandei and from Gazprom Neft's Prirazlomnoye and Novy Port (Arctic Gate) terminals will also be exported to Rotterdam, in part directly and in part via transloading at the Port of Murmansk.

**Figure 2 – Russian Arctic maritime petroleum terminals in operation in 2017**



Source: Bloomberg Gadfly

## Coal

Dry bulk is dominated by coal from Arkhangelsk, Kandalaksha and Murmansk, which comes from the Kemerovo region and is supplied by the Mechel group's mining company Yuzhny Kuzbass (UKUZ), Yukas Holdings' mining company Taltek and the Siberian Coal Energy Company (SUEK) respectively. The main market is the United Kingdom, as well as the Netherlands, Belgium and other European countries. In 2014, SUEK alone exported 14 million tonnes of coal via the Port of Murmansk.<sup>3</sup>

## Hard coal

From 2018, hard coal (anthracite) will also be transported via the NSR from Taymyr, where the company Vostokugol through its subsidiary Arkticheskaja gornaja kompanija (Arctic Mining Company) has developed a field near Dikson since 2015.<sup>4</sup> The first trial shipment occurred in early 2017. The annual production will be 4 million tonnes, rising to 7 million tonnes by 2020. The production can then rise further to 10 million tonnes.<sup>5</sup> With regular operation, exports to Western Europe will occur through collaboration with Arctic Bulk, which operates five Panamax ice-class bulk carriers. The exports are not planned to be shipped directly, but will probably occur through transloading at the Port of Murmansk.

## Phosphate

Another important bulk cargo is phosphate from the fertiliser manufacturer PhosAgro's production in Apatity on the Kola peninsula. This is shipped via the Port of Murmansk to the companies Prayon in Belgium and Yara in Norway. In 2014, this constituted approximately 1.5 million tonnes.<sup>6</sup>

## Iron ore

Iron ore from EuroChem's terminal at the Port of Murmansk goes to China<sup>7</sup>, mostly via the Suez Canal, but in some cases also via the NSR. The company also exports baddeleyite concentrate containing zirconium via the Port of Murmansk, mostly to Japan and Norway. These minerals both come from EuroChem's undertaking in Kovdor on the Kola peninsula.<sup>8</sup>

## 2.2 Import

Virtually no imports to Russia arrive via the northern ports. In volume, this totals about 500,000 tonnes, or 1.5% of all international cargo. In 2016, just eight international container ship calls were registered at the Port of Murmansk and a further two at the Port of Arkhangelsk.

Imports via the Port of Murmansk are dominated by non-organic chemical products, ore, cement, animal feed, copper and fish. In Arkhangelsk, imports are dominated by non-organic and other chemical products.

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<sup>3</sup> SUEK Annual Report 2014

<sup>4</sup> Established in 2010 - <http://vostokcoal.com>

<sup>5</sup> Atomflot, general presentation (2016) – *Atomic Icebreakers Support for the Northern Sea Route*

<sup>6</sup> PhosAgro Annual Report 2014

<sup>7</sup> The Northwestern Customs Directorate of the Federal Customs Service of the Russian Federation (Федеральная таможенная служба Северо-Западное таможенное управление), export statistics for Arkhangelsk and Murmansk, 2012-2016

<sup>8</sup> [www.eurochemgroup.com](http://www.eurochemgroup.com); Global Investment Center, 2013 - *Russia - mineral, mining sector investment and business guide, volume 1*

### Port in Sabetta for Yamal LNG

Since 2015, a lot of general cargo has been received in Sabetta on the Kara Sea. This is mainly machinery, modules and other equipment to build the new port in Sabetta for Yamal LNG as well as the LNG plant, the first phase of which will be operational by the end of 2017. The port is also intended as a future export port for minerals, coal and other cargo transported north on a future rail link. However, the Central Marine Research and Design Institute (CNIIMF) in St. Petersburg considers this as uncertain because there will be little available quay capacity in Sabetta beyond the LNG plant's requirements, and the costs associated with expanding the quay areas at the port will be very high.<sup>9</sup>

In 2015, 1.4 million tonnes of goods arrived in Sabetta by sea – 40% as direct imports and the remainder via the ports of St. Petersburg, Murmansk and Arkhangelsk.<sup>10</sup>

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<sup>9</sup> CNIIMF (20.11.2017)

<sup>10</sup> CNIIMF (2016) - *Анализ грузооборота морских портов Арктики в 2014-2015 гг.* (Analysis of goods via the Arctic ports in 2014-2015)

### 3 THE NORTHERN SEA ROUTE

Compared to the current traffic through the Suez Canal, the Northern Sea Route (NSR) represents a significant reduction of the sailing distance between Southeast Asia and Europe. This route would be particularly favourable between the northern part of Northern Europe (from Germany and northwards) and the Asian countries China, South Korea and Japan.

For example, under favourable navigational conditions on the NSR, the sailing time for a general cargo ship sailing between Yokohama in Japan and Hamburg in Germany can be cut from 34 to 23 days, compared with navigating via the Suez route. This is based on a speed of between 12 and 14 knots over 6,920 nautical miles via the NSR and 11,430 nautical miles through the Suez Canal. Reducing the sailing distance by 40% can reduce the fuel consumption by 20%.<sup>11</sup>

In August 2017, Sovcomflot's LNG tanker *Christophe de Margerie* used just 19 days to sail from Hammerfest in Northern Norway to Boryeong in South Korea. This was approximately 30% quicker than the traditional route via the Suez Canal, and the NSR transit was a new record of 6.5 days.<sup>12</sup>

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<sup>11</sup> Wergeland (2010) - *Arctic Shipping Routes - Cost Comparisons with Suez*

<sup>12</sup> The Medi Telegraph, 23 August 2017 - *Sovcomflot's LNG carrier sets new record with Northern Sea Route transit of just 6.5 days*

**Figure 3 – The Northern Sea Route and The Southern Route via the Suez Canal**



*Source: The journal Week in China*

### **Destination traffic**

In recent years, the destination traffic along the NSR has increased significantly, but this is mostly related to the transportation of machinery, modules and other equipment from Europe and Asia for the development of the port in Sabetta, the Yamal LNG processing plant and other infrastructure related to this megaproject.

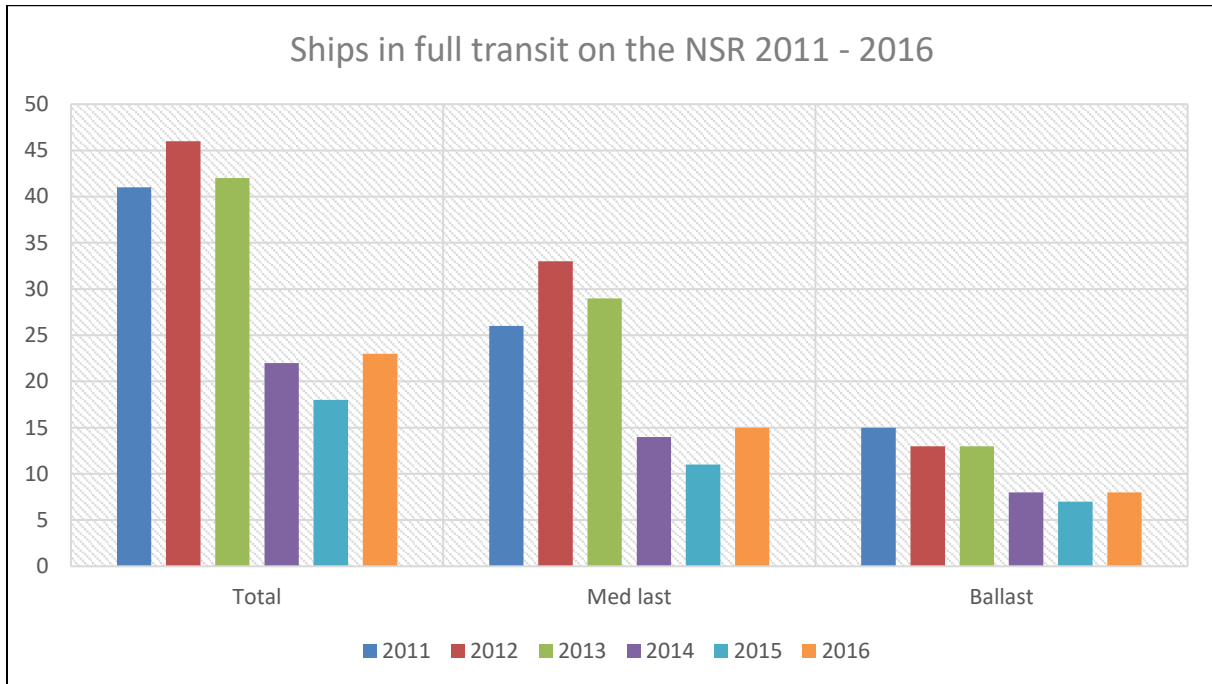
### **Cabotage**

The cabotage traffic on the route has also included cargo to Sabetta via the ports of Murmansk and Arkhangelsk, the transportation of refined nickel and copper from Norilsk Nickel's plant on the Taymyr Peninsula via the river port of Dudinka to Murmansk, diesel and petrol to settlements along the NSR and sporadic shipments of frozen fish from the far east of Russia to St. Petersburg via the Barents Sea.

### **International transit**

Despite the major international focus on the Northern Sea Route North Sea's potential for the transportation of international goods between Asia and Europe, this traffic has so far been negligible and from 2014-16 was just 50% compared with 2011-13. Moreover, a significant proportion of the transits involve vessels without cargo.

**Figure 4 – Ships in full transit on the NSR 2011 - 2016**



*Source: Atomflot*

Med last = Loaded with cargo

For international transit cargo, the NSR is not currently used for liner traffic, but rather for isolated deliveries of bulk cargo or repositioning between Northern Europe and Southeast Asia when the navigational conditions are favourable.

### **The NSR is a challenging route**

There are several reasons why the NSR has so far not become a significant route for international cargo, including a decline in the export of iron ore from Northern Europe to China. Furthermore, the route can only be navigated in the summer months owing to thick sea ice, there are unpredictable navigational conditions in the summer months (drift ice), safe navigation involves costly investments in vessels with additional reinforcement against ice and greater engine power, the need for costly assistance from nuclear-powered icebreakers and the lack of emergency preparedness on long stretches of the route.

Moreover, the current low fuel prices and increased capacity on the Suez Canal have not contributed to increased interest in the NSR. However, these conditions may change through improved conditions, e.g. rising fuel prices, better emergency preparedness and a longer navigation season owing to climate change which has led to thinner ice and a longer ice-free season.

**Figure 5 – Ships with icebreaking assistance navigate thin and scattered ice on a stretch of the NSR**



Photo: SCF Group

From a geopolitical perspective, the NSR can gain increased importance, e.g. if the situation in the Middle East makes navigating the Persian Gulf and the Suez Canal risky due to acts of war and terror.

### 3.1 The NSR and container traffic

To date, the NSR has not been utilised by specialised container ships. From a navigational perspective, such traffic is no more problematic than other ships. However, since container traffic is usually operated as regular liner traffic, the challenges have included shallow waters with a lot of ice. Consequently, with safe navigation of regular liner traffic in mind, one has worked on the assumption that an investment in vessels with reinforcement against ice is a necessity. Increased weight due to reinforcement against ice requires greater engine power and other machinery, which means the ships would be even heavier and deeper in the water. Compared to conventional ships, this makes the ships considerably more expensive to build and operate. Meanwhile, the water depth in the shipping lanes places significant limitations on size and capacity of the vessel.<sup>13</sup>

#### New ship designs for the NSR

Russia and China both wish to utilise the NSR for container cargo based on new ship designs. In 2015, the Federal Agency for Maritime and River Transport in Russia (RosMorRechFlot) approved a concept for an ice-strengthened container ship with a capacity of 3,000 standard containers developed by the Ukrainian Marine Engineering Bureau.<sup>14</sup> In the same year, Jiang Nan Shipyard in Shanghai carried out a feasibility study of Arc-class container ships, and developed a design that can transport 4,000 containers along the NSR.<sup>15</sup> However, the concepts have faced scepticism because the vessels would

<sup>13</sup> Port of Rotterdam (2010) - *The possibilities of container transit shipping via the Northern Sea Route*

<sup>14</sup> Mikhail Grigorev, Gecon, during the 6th Arctic Logistics in Murmansk, 12 April 2016

<sup>15</sup> Arthur Guschin, guest researcher at Fudan University, Shanghai, e-mail 23 and 29 October 2017

be expensive to build and operate. Moreover, they would be bound to the navigation seasons on the NSR and of little use the rest of the year.<sup>16</sup>

### Warmer climate can reduce cargo costs

However, with rising temperatures in the Arctic, less ice and increasingly longer navigation seasons on the NSR, the use of smaller conventional container ships on this route is being assessed. Researchers at Jiao Tong University in Shanghai are currently working on two complex models for comparative scenarios to calculate the profitability of container transport on the NSR vs Suez. This involves the use of container ships with a capacity of 4,800 containers with a low ice class via the NSR and varying vessel sizes via Suez, which is also based on variations in the length of the navigation season via the NSR, variations in the price of fuel and the need for icebreaking assistance, etc.

The work is continuing, and the ongoing efforts will involve several test sailings via the NSR and through the Suez Canal, but individual calculations show, for instance, that the cargo costs for 4,800 containers via NSR is comparable with 15,000 containers via the Suez Canal if the navigation season via the NSR is extended to 222 days (7.4 months).

The Beijing Transport Research Institute is also working on a model for good transport on the NSR. The profitability of this model is reliant on factors such as the availability of accurate ice forecasts for the NSR to enable the most efficient utilisation of the navigation season. Consequently, China is lobbying for the financing and construction of meteorological stations in the European Arctic.

## 3.2 China and container cargo on the NSR

If China chooses the NSR as one of several trade routes for container cargo to and from Europe, this could potentially generate significant traffic. China is the world's largest exporter of goods by container. In 2014, China shipped 36 million TEU, which was three times more than USA in second place, and accounted for almost 20% of global exports. Moreover, China was the world's second largest importer after USA. China's imports totalled 14.7 million TEU – or 11.5% of global imports.<sup>17</sup> Seven of the world's largest container ports (based on the volume of goods) are in China. In 2015, these ports jointly handled 150 million TEU.<sup>18</sup>

**Table 2 – The world's 10 largest container ports (2015) measured by millions of TEU**

Rank	Port	TEU
1	Shanghai, China	36.5
2	Singapore	30.9
3	Shenzhen, China	24.2
4	Ningbo-Zhoushan, China	20.6
5	Hong Kong, China	20.1
6	Busan, South Korea	19.5
7	Qingdao, China	17.5
8	Guangzhou, China	17.2
9	Jebel Ali (Dubai), UAE	15.6
10	Tianjin, China	14.1

<sup>16</sup> Including by researcher Arild Moe from the Fritjof Nansen Institute and analyst Mikhail Grigorev from Gecon, during the 6th Arctic Logistics in Murmansk, 12 April 2016

<sup>17</sup> World Shipping Council, Global Summary of Liner Trade

<sup>18</sup> UNCTAD, Review of Maritime Transport 2016



Source: UNCTAD

If one works on the basis that, as an alternative container route between Asia and Europe, the NSR could have greatest economic significance on stretches that have been emphasized early owing to the difference in sailing distance and (potentially) time compared to using the Suez Canal. It is primarily ports along the coast of Germany and northwards which are of interest in an assessment of the potential flow of goods through the NSR via Kirkenes.

### 3.3 China's trade with selected countries in Northern Europe

**Table 3 – Trade by Germany and Nordic countries with China (tonnes) in 2016**

Country	Imports	Exports	TOTAL
Germany	13 297 000	9 850 335	<b>23 147 335</b>
Finland	379 300	2 200 000	<b>2 579 300</b>
Sweden	1 100 000	1 600 000	<b>2 700 000</b>
Denmark	974 000	688 000	<b>1 662 000</b>
Norway	1 100 000	1 100 000	<b>2 200 000</b>
<b>TOTAL</b>	<b>16 850 300</b>	<b>15 438 335</b>	<b>32 288 635</b>

Source: The national statistics banks

#### Germany

Germany is China's largest trading partner in the EU. In 2016, imports of goods from China (including Hong Kong) totalling 1.9 million TEU arrived at German ports, while exports to China totalled 1.3 million TEU. In comparison with the previous year, there was a slight decline in imports balanced with a corresponding increase in exports.

Hamburg is the largest European port for Chinese goods. In 2016, imports arriving here from China (including Hong Kong) totalled 11 million tonnes and 1.55 million TEU, while exports accounted for 8 million tonnes and 996,000 TEU. In comparison with the previous year, there was also a slight decline in imports and a corresponding increase in exports.<sup>19</sup>

There is also increasing container cargo by railway from Germany to China, but the volume is minor compared to the sea cargo. In 2016, DB Cargo transported more than 40,000 TEU on this stretch, and has the goal of reaching 100,000 TEU by 2020.<sup>20</sup>

#### Finland

Finland is a relatively small European trading partner with China. In 2016, Finland imported 345,000 tonnes of goods in containers. This represents a slight decline from the previous year when imports totalled 346,000 tonnes. Exports totalled 1,458 million tonnes compared to 1,140 million tonnes in 2015, of which 19,000 and 11,000 tonnes respectively were transported by rail.

<sup>19</sup> Statistisches Bundesamt (Destatis) - Goods and units unloaded and loaded (maritime transport): Germany, years, partner countries, major seaports

<sup>20</sup> RailFreight.com, 13 January 2017 - DB Cargo moves 40,000 containers from Germany to China

In comparison, Finland imported 379,300 tonnes of goods directly from China in 2016, while exports totalled for 2.2 million tonnes. The container traffic accounted for 91% of the imports from and 66% of the exports to China.<sup>21</sup>

### Denmark

China is Denmark's 7th largest trading partner. In 2016, Denmark imported goods worth DKK 43.3 billion, which represented 2% of Denmark's import volume and 7.5% of its import value. The imports were dominated by electronics, machinery, textiles, furniture, toys and metal products. The container traffic accounted for 90% of the import volume, which is roughly the same as for Finland, and totalled 877,000 tonnes.

Danish exports to China had a value of DKK 22.5 billion, which represented 1.9% of Denmark's export volume and 3.5% of its export value. The exports were dominated by foodstuffs, leather, pharmaceutical products, machinery and electronics.<sup>22</sup> This composition indicates a higher proportion of containers than for Finland, maybe roughly on a par with the import proportion and, if this is the case, gives 619,000 tonnes of export goods.

### Sweden

China is Sweden's 10th largest export market with a turnover of SEK 46 billion in 2016. On the import side, China is Sweden's 7th largest trading partner with imports totalling SEK 56 billion.<sup>23</sup>

Imports from China (excluding Hong Kong) were on the same level in 2015 and 2016, while exports were slightly higher in 2016 than the previous year. The composition of import goods indicates a high proportion of containers and, if one uses roughly the same proportion as Finland (90%), this gives 990,000 tonnes of import goods.

Sweden's exports are somewhat complex, including bulk, general cargo and RoRo<sup>24</sup> – such as iron ore, heavy machinery and vehicles. If one uses the same proportion as Finland (2/3 containers), this gives 1,056 million tonnes of export goods.<sup>25</sup>

### Norway

Norway imported 0.1 million tonnes more from China (excluding Hong Kong) in 2016 compared with the previous year. However, exports were reduced by 0.2 million tonnes.<sup>26</sup> Around 80% of the imports from and virtually all the exports to China are transported by ship. Roughly 70% of the exports consist of typical bulk products (gas, oil, fertiliser, etc.), so approximately 300,000 tonnes may be grouped as suitable for containers.<sup>27</sup>

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<sup>21</sup> Finland's Customs database Uljas for foreign trade statistics – Container Transport of External Trade

<sup>22</sup> Statistics Denmark, StatBank - Imports and exports CN by unit, imports and exports, country and time; Total external trade by country, imports and exports

<sup>23</sup> National Board of Trade Sweden - Sveriges utrikeshandel med varor och tjänster samt direktinvesteringar. Helåret 2016

<sup>24</sup> RoRo is an abbreviation for Roll-on/Roll-off, which refers to wheeled cargo that may be loaded/unloaded without using a crane, e.g. vehicles.

<sup>25</sup> Statistiska centralbyrån, Statistikdatabasen – Import/export of goods from countries of consignment. Not adjusted for non-response, metric tonnes by commodity group according to CN, trading partner and month

<sup>26</sup> SSB, Statistikkbanken – External trade in goods, by import/export, country, category, year and statistics variables

<sup>27</sup> SSB, Statistikkbanken – External trade in goods (tonnes), by import/export, country, two-digit SITC, mode of transport, year and statistics variables

Across all Norwegian ports in 2016, a total of 255,000 TEU of foreign goods was unloaded as LoLo<sup>28</sup>. In the same period, there were more than 167,000 TEU LoLo of export goods. In total, this constituted a cargo volume of 4.8 million tonnes with an average of 11.5 tonnes of goods per TEU.

In addition, the ports handled a total of 195,000 TEU without cargo of foreign cargo. Taking this into account, the total Norwegian throughput of international LoLo at the ports was 617,000 TEU.<sup>29</sup>

### 3.4 The potential for Chinese goods via the NSR

Based on the previous chapter, we can estimate the volume of goods in containers and the number of TEU to and from China, based on the throughput via the ports in 2016:

**Table 4 – Estimate of the container trade between China and selected countries in Northern Europe**

Country	Imports (tonnes)	TEU	Exports (tonnes)	TEU	Throughput (tonnes)	Throughput (TEU)
Germany	17 732 000	1 927 397	11 897 000	1 293 117	29 629 000	3 220 514
Finland	326 000	35 435	1 439 000	156 413	1 765 000	191 848
Denmark	877 000	95 326	619 000	67 282	1 496 000	162 608
Sweden	990 000	107 609	1 056 000	114 783	2 046 000	222 392
Norway	880 000	95 652	300 000	32 609	1 180 000	128 261
<b>TOTAL</b>	<b>20 805 000</b>	<b>2 261 419</b>	<b>15 311 000</b>	<b>1 664 204</b>	<b>36 116 000</b>	<b>3 925 623</b>

Source: The national statistics banks

Specific figures for the container traffic are available for Germany, while for Finland the figures state the amount of goods in containers. For the other countries, the amount of goods in containers is calculated with Finland as a reference. In addition, assessments have been made of the types of goods that dominate in both directions, and from this an estimate of the proportion of goods transported by container.

#### Basis for calculation of TEU

The calculation of the number of TEU (containers) is based on the average weight of goods per container. There are significant variations here. At the Port of Oslo, for instance, the average weight in 2016 was 9.2 tonnes, while the average was 10.4 tonnes in Hamburg and 8 tonnes in Helsinki.<sup>30</sup> Consequently, when calculating the number of TEU in the Nordic countries, we have used 9.2 tonnes, which is the average weight for these three ports.

Based on this calculation, this gives total imports of 2.26 million TEU from China to five of the northernmost coastal countries on the European mainland, with the most distant favourable location in terms of distance to the western part of the NSR. This equates to an import of 6,200 TEU per day.

If one supposes that some of this volume could be transported from China via the NSR, one could use as a basis the Chinese model based on a 222-day navigation season and 4,800 TEU per vessel. For

<sup>28</sup> LoLo is an abbreviation for Load-on/Load-off, refers to cargo that is loaded/unloaded by crane.

<sup>29</sup> SSB, Statistikkbanken – Port statistics. Goods, by ports, type of container, direction, domestic/foreign, year and statistics variables

<sup>30</sup> Port of Hamburg, Annual Report 2016; Port of Helsinki, Annual Report 2016; Oslo Havn KF, Annual statistics 2016

example, if we move 10% (226,000 TEU) of imports in 2016 from the Suez Canal to the NSR, one would receive a container ship with cargo from China to Europe on the NSR every fifth day throughout this period of the year.

### 3.5 The potential from other trading partners in Southeast Asia

Other economies in Southeast Asia are also extremely relevant in an NSR transit perspective, especially South Korea and Japan, which are major export nation which transport a large share of this cargo to Europe by container.

**Table 5 – Foreign trade (1,000 tonnes) with South Korea, Japan and Taiwan in 2016**

Country	Taiwan		South Korea		Japan		TOTAL	
	Import	Export	Import	Export	Import	Export	Import	Export
Country	762	596	1 272	1 431	1 280	1 397	<b>3 314</b>	<b>3 424</b>
Finland	27	107	76	177	23	873	<b>126</b>	<b>1 157</b>
Denmark	43	35	118	76	24	179	<b>185</b>	<b>290</b>
Sweden	90	136	173	253	81	657	<b>344</b>	<b>1 046</b>
Norway	36	138	47	290	183	640	<b>266</b>	<b>1 068</b>
<b>TOTAL</b>	<b>958</b>	<b>1 012</b>	<b>1 686</b>	<b>2 227</b>	<b>1 591</b>	<b>3 746</b>	<b>4 235</b>	<b>6 985</b>

Source: The national statistics banks

A calculation may also be based on moving 10% of the combined import from these three Asian countries to the NSR during the navigation season. This amounts to 424,000 tonnes. Based on the estimated average weight of 9.2 tonnes of goods per container, this would amount to a further 46,087 TEU from Asia to Europe along this route – or one cargo ship every third week during the navigation season.

Germany has reliable statistics on its container traffic and trade, which provides a good picture of the actual container trade with countries in Southeast Asia:

**Table 6 – German foreign trade (TEU) via the largest ports in 2016**

Country	Unloaded	Loaded	TOTAL
Taiwan	86 304	83 505	<b>169 809</b>
South Korea	210 255	196 460	<b>406 715</b>
Japan	55 385	109 132	<b>164 517</b>
<b>TOTAL</b>	<b>351 944</b>	<b>389 097</b>	<b>741 041</b>

Source: Statistisches Bundesamt, Destatis

Finnish trade statistics state the volume transported by container to and from the different trading partners. If as previously we use 9.2 tonnes as the estimated average weight, this gives us an impression of what this trade can constitute in terms of utilisation of the railway line capacity.

**Table 7 – Finnish foreign trade (tonnes) shipped by container in 2016**

Country	Imports	TEU (estimate)	Exports	TEU (estimate)
Taiwan	25 000	2 717	105 000	11 413
South Korea	31 000	3 370	164 000	17 826
Japan	14 000	1 521	839 000	91 196
<b>TOTAL</b>	<b>70 000</b>	<b>7 608</b>	<b>1 108 000</b>	<b>120 435</b>

Source: Finland Customs' database Uljas

### 3.6 Baltic Sea tunnel and the cargo basis via the NSR without Germany

If one works on the basis that 10% of the current container volume between the selected Northern European countries and Southeast Asia is transported via the NSR, the above calculations show that imports to Germany will be decisive for determining whether there is a cargo basis on an Arctic railway. Germany accounts for 85% of the imports from China, and 78% of the total imports from the three other countries.

Given the current situation, the transportation of goods to and from Germany on an Arctic railway would face a challenge as Finland has no direct rail link with Germany or the Baltic States. Trains are currently reliant on travelling via Russia or Sweden (via Denmark). An alternative to this is a rail ferry, but this would involve a significantly longer transportation time and significant additional costs, weakening the railway line's competitive advantage.

#### Time savings by rail link

With a continuous and efficient rail link from Kirkenes to Germany via Helsinki, the three Baltic countries and Poland (total distance of 2,600 to 2,700 km), a train could complete the journey in just over 24 hours at a speed of 100 km/h.<sup>31</sup> By comparison, the distance from Kirkenes to Hamburg via the NSR is 1,530 nautical miles (4,300 km). At an economical speed of 14-15 knots, a ship would require around 4.5 days to complete the journey.<sup>32</sup>

#### Rail Baltica

Work is currently underway within the EU to resolve the bottleneck that this lack of direct link represents for efficient cargo and passenger transport between Northern and Central Europe, including through the Rail Baltica project. This project, which is in three stages, involves the construction of a new railway line between Tallinn in Estonia and Warsaw in Poland. It is scheduled for completion in 2026.<sup>33</sup>

#### Tunnel under the Baltic Sea

However, Rail Baltica is also based on a ferry link between Helsinki and Tallinn, so this option will not remove the bottleneck for the transportation of goods in and out of Finland. To solve this problem, the EU has funded a preliminary study of a project to the construct of a 92 km-long subsea tunnel between the two capitals. If realized, the tunnel will be the longest in the world of its kind, and could be operational between 2030 and 2035.<sup>34</sup>

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<sup>31</sup> Finish Transport Agency - *Finnish Railway Network Statement 2017*. In Finland, the maximum speed permitted for goods trains is 120 km/h.

<sup>32</sup> Bergen og omland havnevesen, *distansetabell sjø*

<sup>33</sup> Wikipedia – *Rail Baltica*

<sup>34</sup> Railway Technology - *Helsinki-Tallinn Railway Tunnel, Gulf of Finland*

**Figure 6 – Latvian map showing the main trade route for Rail Baltica, which is under construction**



Source: Ministry of Transport and Communication of the Republic of Latvia

### Access to markets in much of the Baltic Sea region

This railway line would provide faster access to the countries in between. Estonia, Latvia, Lithuania and Poland are all growing economies, which have significant trade with China.

Sailing from Shanghai in China to Gdansk in Poland currently takes between 26 and 36 days via the Suez Canal at an average speed of 13 to 18 knots. Transportation via the NSR with transloading to rail

in Kirkenes, rather than sailing the entire route via the NSR to the Baltic Sea, could deduct 2 to 3.5 days in addition to the savings already achieved by utilising this route.<sup>35</sup>

**Table 8 – China's trade with the Baltic countries and Poland in 2016 (tonnes)**

Country	Estonia	Latvia	Lithuania	Poland	TOTAL
Imports	99 073	107 096	231 057	2 928 097	<b>3 365 323</b>
Exports	229 242	503 378	237 131	641 865	<b>1 611 616</b>
<b>TOTAL</b>	<b>328 315</b>	<b>610 474</b>	<b>468 188</b>	<b>3 569 962</b>	<b>4 976 939</b>

Source: Eurostat

By using the same conversion and proportion as previously, this could constitute an additional volume of 37,000 TEU – or 296 complete trains – as import via an Arctic railway.

#### Lack of direct link

The lack of a directly railway link from Helsinki can make goods traffic from Asia via the NSR and an Arctic railway to the Baltic region, Poland and Germany less competitive. However, this does not necessarily mean that the cargo basis for such railway line no longer exists, but will instead depend on the flow of goods via the NSR to and from the Nordic countries increasing considerably.

Based on the previous tables, one can then use as a basis a combined estimate of the container trade with China, Taiwan, South Korea and Japan based on statistics of imports in tonnes and an average weight of 9.2 tonnes per TEU:

**Table 9 – Estimate of imports (TEU) to the Nordic countries from Southeast Asia**

To/from	China	Taiwan	South Korea	Japan	TOTAL
Finland	35 435	2 935	8 261	2 500	<b>49 131</b>
Denmark	95 326	4 674	12 826	2 609	<b>115 435</b>
Sweden	107 609	9 783	18 804	8 804	<b>145 000</b>
Norway	95 652	3 913	5 109	19 891	<b>124 565</b>
<b>TOTAL</b>	<b>334 022</b>	<b>21 305</b>	<b>45 000</b>	<b>33 804</b>	<b>434 131</b>

Source: The national statistics banks

This is only intended to give an indication since there are grounds for significant discrepancies. For instance, large quantities of car are imported from Japan, which are transport as RoRo cargo and not by container. Moreover, the weight of container goods varies considerably.

#### Estimate with or without Germany

The estimate based on 10% of the container imports transported via the NSR in which Germany was included as a recipient country gave 272,000 TEU as the basis for the traffic calculation via the Port of Kirkenes and an Arctic railway. The above table shows that maintaining the same number of containers as imports from the Southeast Asian countries to the Nordic countries alone will depend on 60% of the current volume being transported via the NSR.

Initially, it can appear that this would have a huge negative impact on the current import ports. However, if one considers the time that it would take to build a railway line and the expected growth in the container trade between Asia and Europe up to 2040, as well as the fact that this would give

<sup>35</sup> <https://sea-distances.org>

current ports time and opportunities to adapt for competition from the NSR ports, the effect could be much less dramatic.

### 3.7 Russia and container cargo via the NSR

Russia is using the following basis to assess its container traffic along the NSR:

- ✓ Domestic trade between Russian ports in Europe and in the far east (Murmansk, Petropavlovsk-Kamchatsky, Vladivostok, Vostochny and Magadan)
- ✓ Import trade between Russian and Asian ports (Murmansk and Petropavlovsk-Kamchatsky)
- ✓ Transit trade between Russian hubs (Murmansk and Petropavlovsk-Kamchatsky);
- ✓ Transit trade between Northern Europe and Asia

#### Fish important in Russian domestic trade

The potential cargo for Russian domestic trade includes fish from ports in the far east to Murmansk, and from European Russia (Murmansk and St. Petersburg) to the far east. In 2015, 2.3 million tonnes of fish were landed in the far east of Russia, of which 63% was Alaska pollock. Statistical calculations show that the annual local consumption of fish in the Russian far east is 500-600,000 tonnes. The remainder is sold to other parts of Russia or internationally.

However, much of the fish never reaches the market and remains in freezer storage locally due to the high price of unsubsidised freezer freight by railway to European Russia. One solution is regular shipments of fish from the far east ports to Murmansk and St. Petersburg via the NSR.

In 2014, Russian ports handled 5.28 million TEU, of which 3.61 million contained cargo.

**Table 10 – The largest Russian container ports in 2014**

Port	TEU (2014)	Share (%)
St. Petersburg	2 375 500	45
Vladivostok	870 100	16.5
Novorossiysk	721 200	13.7
Vostochny	474 700	9
Kaliningrad	325 200	6.2
<b>TOTAL</b>	<b>4 766 700</b>	

*Source: Association of Russian Sea Ports*

The domestic container trade between Russian ports is too small to justify regular liner traffic. Russia believes one solution is to establish two major maritime hubs: one in the north (Murmansk) and the other in the far east (Petropavlovsk-Kamchatsky). This would ensure balanced operations by using container ships with ice class in shuttle traffic along the NSR.

#### Murmansk

Murmansk as a container hub for cargo to and from the far east of Russia is in harmony with the development of the Murmansk Transport Hub – the long-standing and comprehensive plans for port development, the logistics areas and associated transport infrastructure. This includes a new container port with an annual capacity of 1 million TEU. Similar plans exist for development of the Port of Petropavlovsk-Kamchatsky, which can increase its annual container capacity to 500,000 TEU.



### Cargo basis for the Russian container route

Potential cargo for an Arctic Russian container route could include fish from Petropavlovsk-Kamchatsky to Murmansk or St. Petersburg (300,000-400,000 tonnes), shipments of food to the far east of Russia from European Russia (via the ports of St. Petersburg or Murmansk), transit cargo between Asia and Europe (600,000/400,000 tonnes) and Russian exports.

**Table 11 – Prognosis for the volume of Russian container cargo via the Northern Sea Route**

Destination / type of cargo	Volume	
	000 tonnes	TEU
<b>Petropavlovsk-Kamchatsky - Murmansk</b>	1 050	80 000
- Transit cargo	600	46 000
- Russian foreign trade	100	7 000
- Russian domestic cargo (frozen fish)	350	27 000
<b>Murmansk - Petropavlovsk-Kamchatsky</b>	750	57 000
- Transit cargo	400	31 000
- Russian foreign trade	200	15 000
- Russian domestic cargo (frozen foodstuffs)	150	11 000
<b>TOTAL</b>	<b>1 800</b>	<b>137 000</b>

Source: Central Marine Research and Design Institute CNIIMF)

### Directional balance

Such liner traffic would also generate transport of a volume of empty containers. Consequently, Russia considers that a balanced container route which is also able to comply with delivery requirements would require the departure of a container ship from the port at least once every 14 days. When it comes to the estimated volumes, on the one hand a higher frequency could mean less cargo per sailing owing to the producers not managing to follow up. On the other hand, a lower frequency would increase the volume of containers stored at the port and, as such, result in a longer delivery time to the buyer.<sup>36</sup> The Russian calculations work on the basis that the average weight of goods per container is 13 tonnes.

## 3.8 Environmental challenges associated with shipping on the NSR

The International Maritime Organization (IMO), of which 171 of the world's 195 nations are members, has drawn up a set of rules to prevent pollution from ships. These rules are contained in the *International Convention for Prevention of Pollution from Ships*, which is known as MARPOL 73/78. The convention has two sets of requirements for emissions and fuel quality: global requirements and a more stringent requirement for ships in emission control areas (ECA).

An emission control area may be designated for sulphur oxides (SOx) and particulate matter (PM), or for nitrogen oxides (NOx) – or may be for all three of these types of emissions. There are also special fuel quality directives for SOx emission control areas (SECA).

Existing emission control areas include the Baltic Sea and the North Sea. In the Baltic Sea, the SECA was established in May 2005. As of 1 January 2015, the maximum allowable sulphur content in

<sup>36</sup> Central Marine Research and Design Institute - CNIIMF (2016) – *Forecast of transit container traffic on the Northern Sea Route*

marine fuels for ships operating here is 0.1%. However, heavy fuel oils (HFO) are still allowed providing they comply with the current sulphur limit.

### **Reduction of sulphur emissions**

Globally and within the SECA, the IMO allows alternative measures aimed at reducing sulphur emissions, e.g. the use of scrubbers. To meet the maximum sulphur content limit of 0.1% within the SECA, ships may install exhaust gas cleaning systems or other technical solutions to reduce emissions. For example, the shipping and logistics company DFDS Seaways considered two alternative solutions:

1. Replace heavy fuel oil on its ships with gas oil. Although gas oil costs around 1.5 times more, it contains significantly less sulphur
2. Upgrade its fleet with scrubbers

After three years of testing with a manufacturer combined with improvements in scrubber technology, DFDS decided to upgrade its fleet. This will cost several hundred million euros, but in January 2015 DFDS had 10 ships ready to sail in the area subject to the new sulphur limits.

### **The Polar Code**

The IMO has also adopted the International Code for Ships Operating in Polar Waters, known as the Polar Code, which entered into force on 1 January 2017. It contains mandatory provisions, implemented through SOLAS (safety) and MARPOL (prevention of pollution), and recommendations.

The mandatory provisions include: Ice class A/B for all oil tankers, and that untreated sewage may not be discharged within 12 nautical miles of an ice shelf. Moreover, the IMO recommends that ships do not use or carry heavy fuel oil in Arctic waters.<sup>37</sup>

### **Europe**

In Europe, there is a strong political pressure to adopt a significantly more restrictive policy concerning the use of heavy fuel oils in the Arctic: On 28 November 2017, the European Parliament adopted a resolution requiring the EU to implement measures to ban heavy fuel oils in the Arctic. The matter will be discussed at the IMO's Maritime Environment Protection Committee meeting in April 2018.<sup>38</sup> Fuel regulations such as these already have a major significance on shipping in the Baltic Sea and North Sea, forcing modifications and eventually other mechanical and fuel solutions for new ships. As such, it will not specifically affect future traffic on the NSR, but rather suggests that in the future all global shipping will have a stronger environmental profile.

### **The Northern Sea Route**

From an environmental perspective, the effects of climate change with higher temperatures and melting of permafrost represent more relevant and specific challenges for shipping on the NSR. A warmer Arctic can create more favourable conditions for shipping by keeping the entire NSR open for an extended season and perhaps it may be ice-free as early as 2030. However, rising temperatures in the Arctic may lead to unfavourable developments such as significantly more drift ice and more unstable and volatile weather conditions, which combine to make the route more challenging to navigate.<sup>39</sup>

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<sup>37</sup> Alexei Bambulyak, memo, 24 November 2017 – *Environmental limitations for shipping in the Baltic and North Seas and in the Arctic*

<sup>38</sup> Arctic Now, 29 November 2017 - *Euro parliament continues push for Arctic HFO ban*; Shipping Tribune, 29 November 2017 - *MEPs demand dirty fuel ban in the Arctic and global action on ship CO2*

<sup>39</sup> Arctic Monitoring and Assessment Programme (2017) - *Snow, Water, Ice and Permafrost in the Arctic*

## 4 KIRKENES AS A TRANSSHIPMENT PORT WITH RAIL LINK

### Russia

A Russian container route between Petropavlovsk-Kamchatsky and Murmansk transporting 137,000 TEU or more per year can also represent a cargo basis between the ports of Murmansk and Kirkenes, provided there is a railway link to Rovaniemi. This may be a proportion of cargo to and from Europe for a Russian container route via the NSR and a proportion of Russian domestic cargo to and from St. Petersburg. An effective rail link already exists between Helsinki and St. Petersburg, and with a link between Helsinki to Kirkenes, transport times and rates could both be competitive.

### China

If 10% of China's exports to Germany, Finland, Sweden, Denmark and Norway in 2016 were shipped via the NSR to the Port of Kirkenes for transloading for southbound rail transportation, this would constitute 1,018 TEU per day – or a vessel with 4,800 TEU every fifth day – within a 222-day sailing window on the NSR. Converted to standard 12-metre railway wagons each carrying two TEU, this would create around 29 km of railway freight, i.e. about 38 complete trains in the direction of Rovaniemi. This would require eight south-bound trains per day to keep pace with the unloading.<sup>40</sup>

In addition, one must work on the basis that there will be roughly the same number of wagons from Rovaniemi to Kirkenes transporting a combination of empty return containers and export cargo to China to fill up the container ships for the return voyage. This traffic alone would generate around 16 freight trains carrying 1,900 – 2,000 TEU per day through the Port of Kirkenes and on the stretch Kirkenes – Rovaniemi for a period of 7-8 months per year.

### Taiwan, South Korea and Japan

If 10% of the combined imports to the four Northern European countries in 2016 from South Korea, Japan and Taiwan were shipped via the NSR to Kirkenes within a navigation window of 222 days with 4,800 TEU per ship, this would generate 9.6 calls with cargo. This means a call every third week in addition to the container traffic from China. Based on two TEU per wagon, a wagon length of 12 m and a train length of 750 m, this would provide 49 additional trainloads of cargo from Kirkenes to Rovaniemi per month (or 1-2 per day).

This traffic has the potential to increase through extended navigation seasons owing to rising temperatures in the Arctic, and since the maritime container traffic between Asia and Europe is growing by 4-5% per year. In Western Europe, this is expected to increase by 50% in 2030, compared with 2013, which the increase between 2030 and 2050 is expected to be more than 70%.<sup>41</sup>

### Other countries Asia

With favourable distances and navigational conditions, container traffic between Southeast Asia and Europe through the NSR could also be generated from other Asian trading partners, other parts of Northern Europe (e.g. the Baltic countries and Poland) and to/from ports on the east coast of USA and Canada. This could also contribute to further growth of goods via a container port in Kirkenes and traffic growth on an Arctic railway to Rovaniemi.

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<sup>40</sup> The permitted length of a goods train in Europe is generally 750 m, cf. [www.researchgate.net](http://www.researchgate.net)- *What is the maximum length of a train in your country?*

<sup>41</sup> OECD/ITF (2017) - ITF Transport Outlook 2017

## 5 FINNISH CARGO BASIS FOR AN ARCTIC RAILWAY

As shown above, transporting a relatively modest proportion of China's maritime container cargo between Germany and the Nordic countries via the NSR would provide a solid basis for an Arctic railway from Rovaniemi to the Port of Kirkenes. However – in the meantime at least – this would be seasonal with a navigational window of 7-8 months.

However, if an Arctic railway is going to be economically sustainable, it must have traffic that provides year-round activity at the railway line's hub. Although earlier studies of an Arctic railway point out that such a line is expected to generate new economic activity along the route when it is in place, it is important to identify the basis that already exists or is currently under development.

Earlier studies have mostly focussed on the exploitation of natural resources in Finnish Lapland, such as volume-based mining (iron ore) and forestry. Passenger traffic (tourism) has also been mentioned.

### 5.1 Minerals

According to a report from the Finnish Transport Agency (Liikenneverkko) in 2013, mining projects, which were then under planning in northern and eastern Finland, would generate a transport requirement of a total of 25 million tonnes of minerals. This included the Sokli mine in Savikoski (phosphate), Hannukain in Kolari (iron oxide and copper), Suhanko in Ranua (platinum, copper and nickel) and Mustavaara in Taivalkoski (vanadium and titanium). However, this cargo potential is now considered to be significantly overestimated.<sup>42</sup>

Four years later, the new mining projects in Lapland are still not realized due to factors including time-consuming planning processes and unfavourable market developments. However, the natural resources remain, and one assumes that several of the mines will enter operation in the years ahead as the geological *Scandinavian Shield and the Central Lapland Greenstone Belt* is considered very promising for minerals such as nickel and copper. Several exploration projects are in progress, and the probability of new discoveries is considered high.

Boliden's Kevitsa mine in Sodankylä produces 250,000 tonnes of concentrate annually. However, most of this is transported to the company's smelter in Harjavalta in Southern Finland and Rönnskär in Sweden.<sup>43</sup>

Sakatti mine, 20 km north of Sodankylä, is scheduled to be in production in 2031. The production and transport volume will be on roughly the same level as Kevitsa.<sup>44</sup>

Outokumpu Chrome's Kemi mine in Elijahvi produces 1.3 million tonnes of chromium annually, all of which is transported to Outokumpu's stainless steel mill Tornio. Consequently, this does not generate the need for an Arctic railway.

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<sup>42</sup> Utviklingssjef Timo Lohi, Northern Lapland, e-mail 4 January 2018

<sup>43</sup> Boliden – *Annual Report 2016*

<sup>44</sup> Lohi, *ibid.*

## 5.2 Timber and biofuels

The forestry industry is a major contributor to the Finnish national economy, accounting for more than 20% of Finland's export earnings. In 2016, Egypt, Japan, the UK, China and Algeria were the five largest export markets for the Finnish sawmills, each with 500,000 to 1.2 million m<sup>3</sup>.<sup>45</sup>

Fifty-nine companies currently operate a total of 90 sawmills in Finland, but production is dominated by four companies: Stora Enso, UPM, MetsäWood and Versowood. Most sawmills and processing plants are in the south of the country; including the Oulu district, there are just 10 sawmills in Northern Finland. These have a total annual production of more than 4 million m<sup>3</sup>. However, there are sawmills in the north with considerable capacity, including Keitele Timber in Kemijärvi, which has an annual capacity of 300,000 m<sup>3</sup>.<sup>46</sup>

### The bioindustry

The bioindustry in Finland is growing rapidly, and several projects are under development. In Lapland, bio refineries are planned in Kemi and Kemijärvi, which by 2022 could have a production of around 500,000 tonnes per year. This would generate the need for significant transportation, especially of raw materials to the factories.<sup>47</sup>

For the timber industry, one works on the basis that each train has 53 flat wagons, each with a length of 14 m and a capacity of 33 cubic metres. Based on 4 million cubic metres, this equates to 121,200 wagons or 2,287 complete trains per year. This would generate an average of 6.3 trains per day on an Arctic railway in Finnish Lapland.

### Timber to Asia

Finnish timber exports to Asia through the NSR via Kirkenes are relevant since this continent accounts for 19% of the export value from the Finnish forest industry.<sup>48</sup> As this cargo is transported by container, for China's part this is already included in the estimate of container cargo from Finland in previous chapters.

However, by adding other countries in Southeast Asia, the volume would increase substantially without a need to change the relative proportion of exports from the Suez Canal to the NSR.

Finnish exports of timber are unlikely to make a significant contribution towards the year-round operation of an Arctic railway because other export markets within favourable sailing distances would be to the west when the NSR is closed in winter. Iceland, Canada and the east coast of North America are the most favourable markets in terms of distance. However, the United States and Canada are the world's two largest exporters of sawn wood, accounting for more than 30% of the overall global export value for this sector.<sup>49</sup>

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<sup>45</sup> The Finnish Sawmills Association

<sup>46</sup> [www.keitelegroup.fi](http://www.keitelegroup.fi)

<sup>47</sup> Lohi, *ibid.*

<sup>48</sup> Finish Forest Industries, 2016

<sup>49</sup> [www.worldstopexports.com](http://www.worldstopexports.com) - Sawn Wood Exports by Country

## 6 NORWEGIAN CARGO BASIS FOR AN ARCTIC RAILWAY

On the Norwegian side, where the railway line is unlikely to exceed 50 km, there is not the same basis in terms of volume as in Finnish Lapland.

A possible restart of the iron ore mining operations in Bjørnevatn and Kirkenes would require a terminal for the shipping of concentrate or pellets, but such a terminal already exists from earlier, and exports of these products are not reliant on an external rail link.

Any new mining operations in East Finnmark would probably be most profitable by establishing their own rail link to their own export quay near the mine. Consequently, mining is not considered a realistic basis for the operation of the Arctic railway.

Currently, two-thirds of the overall goods are transported in and out of Finnmark County by road along the route Bodø - Narvik - Kirkenes, while one-third are transported via the sea route. Scattered settlement in a large region – combined with the “door to door” logistics in the grocery and wholesale trade – indicates that this transport pattern will be maintained in the future. However, sea transport is used for bulk cargo on the route Finnmark - Narvik.<sup>50</sup>

### 6.1 Minerals

Large volumes of minerals linked to an Arctic railway would only be relevant if the iron ore mining operations in Bjørnevatn and Kirkenes resumed. Such operations would require a terminal for the shipping of concentrate or pellets, but such a terminal already exists from earlier, and exports of these products are not reliant on an external rail link.

Any new mining operations in East Finnmark would probably be most profitable by establishing their own rail link to their own export quay near the mine. Consequently, mining is not considered a realistic basis for the operation of the Arctic railway.

### 6.2 The aquaculture industry

Finnmark is a major county for aquaculture with 92 licenses to farm salmon, trout and rainbow trout spread across 75 locations. However, all the fish farms are owned by just five companies.<sup>51</sup> In 2014-2016, an average of 90,000 - 96,000 tonnes of salmon were harvested annually (measured in round weight).<sup>52</sup> Approximately 80% of Norwegian salmon is exported as fresh, whole fish.

The salmon is transported by well boat from the fish farms to the processing plants within and outside the county. In Finnmark, Cermaqu owns Rypefjord Slakteri near Hammerfest, while Grieg Seafood has a processing plant at Simanes near Alta. At Jakobsnes near Kirkenes, Salmar and Lerøy jointly own Kirkenes Processing, which is the smallest of the three processing plants in the county. In

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<sup>50</sup> Nasjonal transportplan (2015) - *Godsanalyse. Delrapport 1: Kartlegging og problemforståelse*

<sup>51</sup> Norwegian Directorate of Fisheries (2016) - *Nøkkeltall fra norsk havbruksnæring*

<sup>52</sup> SSB, statistikkbanken - *Aquaculture. Sale of slaughtered fish for food by region, fish species, year and statistics variables*

2016, the three processing plants had a combined production of more than 65,000 tonnes, including silage and trimmings, or an average of around 5,500 tonnes per month.<sup>53</sup>

From an Arctic railway perspective, it is a challenge that the two largest processing plants are in the west of the county, and that the industry's production and logistics solutions are well adapted to road transport. The salmon is delivered fresh by lorry direct from the processing plant to the buyer's warehouse in Europe within the space of a few days without the need for any reloading.

Transferred from road to rail with refrigerated containers (reefers) carrying 19 tonnes of fish, the combined production from the processing plants in Finnmark would generate 3,420 wagons per year – or roughly 40 complete trains. With regular production throughout the year, this would generate almost one complete train per week. Even under optimal conditions, Finnmark's aquaculture industry is unlikely to be a major driving force for a rail link. However, theoretically it could form a significant part of the line's cargo basis in winter when there is no goods traffic via the NSR.

### 6.3 The fisheries industry

The situation is similar when it comes to the export of fresh fish from the traditional fisheries industry in the county. A total of 266,000 tonnes of fish was landed in Finnmark in 2016, most of which is raw material for internal processing in the industry or exported directly as round, fresh fish. Several fish reception centres are situated within a driving distance of 2-3 hours from Kirkenes, meaning that in some cases rail cargo could be competitive in terms of both price and time. However, this would depend on where in Europe the buyer is located.

Frozen fish is of more interest from a rail perspective as it is not perishable and quick delivery is not required, enabling larger volumes to be stored and transported together.

**Table 12 – Landing of fish (tonnes) in municipalities in Eastern Finnmark**

Municipality	2014	2015	2016
Sør-Varanger	15 969	14 724	18 090
Nesseby	501	617	273
Vadsø	1 006	835	530
Vardø	7 189	8 022	6 985
Båtsfjord	57 435	85 786	92 022
Berlevåg	17 685	16 580	13 217
Tana	103	17	557
<b>TOTAL</b>	<b>99 888</b>	<b>126 581</b>	<b>131 674</b>

Source: SSB

Kirkenes and more traditional fishing ports in East Finnmark have large capacity to store frozen fish. In 2004, 43,000 tonnes of fish were unloaded in Kirkenes. This was mostly frozen cod, but also included frozen shrimps. After 2008, this volume fell considerably, and from 2013-2016 the annual volume averaged between 14,000 and 18,000 tonnes. Using our conversion, this equates to between 1,522 and 1,956 containers – or 10-15 complete trains.<sup>54</sup>

<sup>53</sup> Transportutvikling AS (2017) - *Status 2016 Nærings- og godstransporter i Finnmark*

<sup>54</sup> SSB, Statistikkbanken - Fangst, etter landingskommune, fangstart, tid og statistikkvariabel

## 6.4 Waste disposal

In 2016, the public and private waste disposal companies in Finnmark handled around 100,000 tonnes of household and industrial waste, most of which was transported out of the county for further treatment. More than 85% of the transport was by road, while the remainder – mainly metals – was shipped via the sea.

The waste disposal companies sort the waste and forward it to various recycling companies in Norway and abroad. A proportion of the waste remains in Finnmark for storage, disposal at traditional landfills, composting or environmental treatment.

Of the waste transported out of the county, 48% went to Sweden, primarily as raw materials for incineration plants in Kiruna, Boden, Umeå, Sundsvall and Östersund, among other places, while 19% went to facilities in Southern Norway.<sup>55</sup>

Working on the assumption that 90% of the waste left Finnmark, the proportion transported by road to Sweden and Southern Norway amounts to approximately 50,000 tonnes. On average, this equates to 4,100 - 4,200 tonnes per month – or at least three complete trains.

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<sup>55</sup> Transportutvikling AS (2017) - *Status 2016 Nærings- og godstransporter i Finnmark*



## 7 TOURISM

An Arctic railway could attract a significant number of tourists if it is adapted for passenger traffic along the entire route Helsinki - Rovaniemi - Sodankylä - Ivalo - Kirkenes. Tens of thousands of Asian tourists already fly to Helsinki and on to Rovaniemi, Ivalo and other destinations in Finland, and this market is experiencing rapid growth. A steadily increasing proportion travels by bus from Finland to Kirkenes, while this segment is also growing on the Norwegian side, in part due to Hurtigruten.<sup>56</sup>

However, the potential for transferring some of the flow of tourists from bus and aircraft to train is difficult to quantify as no comparable figures exist.

In 2017, the tourism industry in Finnish Lapland had 2.3 million guest nights, of which 1 million were foreign nationals. Of these, 738,000 were from Europe, 189,000 from Asia and 45,000 from Russia.<sup>57</sup>

By the end of October 2017, the tourism industry in Finnmark County had 611,000 guest nights, of which 242,000 were foreign nationals. The Varanger region's share was 132,000 guest nights, of which 54,000 were foreign nationals.<sup>58</sup>

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<sup>56</sup> Norway Today, 7 February 2017 - *Chinese tourist boom for Hurtigruten*

<sup>57</sup> Visit Finland, Statistics Service Rudolf - *Yearly nights spent and arrivals by country of residence by Region, Country, Data and Year*

<sup>58</sup> Statistikknet Reiseliv - *Kommersielle overnattinger - Hittil i år*

## 8 RAILWAY AND COMMUNITY DEVELOPMENT

### 8.1 Railway

A railway link between Rovaniemi and Kirkenes was last assessed in 2014 when a working group led by Pöyry Finland Oy studied a possible line from Rovaniemi - Kemijärvi - Kirkenes as part of the broader Interreg project Barents Freeway.

This assessment of the social impact concluded that the new railway line would be of greatest importance for industry and trade, as it would create a new and alternative link for the transportation of goods between Northern Finland and Europe. It would also have a major impact on the port and logistics sector, especially in the Kirkenes region, as the model of the flow of goods showed there was demand.

The tourism industry would also have a new alternative for planning its portfolio of services. However, tourism was not included in the economic analyses included in the study.

Pöyry pointed out that the current situation without a rail link is an obstacle to both regional and economic development in Northern Finland, and for opportunities for cooperation between Northern Finland and Finnmark County. Major regional industrial investments, such as new mines, would be potential users and will benefit from a future rail link. The rail link would also make Lapland and Northern Finland more attractive for the establishment of new activities.

The transportation of goods based mainly on general cargo and containers, as well as Finnish dry bulk (ore) via the NSR would necessitate the construction of a large terminal port in Kirkenes linked to an Arctic railway.

### 8.2 Port

#### Volume and capacity

In our conservative estimate, 275,000 TEU would enter via the NSR and the Port of Kirkenes from China, South Korea, Japan and Taiwan. To achieve a balanced liner traffic, one can add the same number of TEU (empty or with export cargo) on the return leg, providing an annual throughput of 550,000 TEU.

In addition, there is general cargo and goods throughput from within the region, as well as RoRo (vehicles), neither of which have been quantified.

Furthermore, there is the transportation of dry bulk from mines in Northern Finland, which will continue to increase as new mining projects are implemented. The proportion of this which could be exported via the Port of Kirkenes is yet to be quantified because there is still uncertainty about the extent to which smelting and other processing will occur at facilities in Northern Finland. Regardless of this, we are talking about significant volumes.

Focussing solely on containers, the estimated volume is nearly three times the throughput at the Port of Oslo, Norway's largest container port with 207,000 units in 2016. However, the volume amounts to 70% of the container traffic at the Port of Gothenburg, Scandinavia's largest port.

For Kirkenes, we are talking about a container season of about 7.5 months, which gives a throughput of 74,000 TEU per month. In comparison, the two other ports operate year-round and have an average monthly throughput of 17,250 TEU (Oslo) and 66,500 TEU (Gothenburg).

### **Capacity on the scale of Gothenburg**

This means in practice to serve the NSR under the given assumptions, the container port capacity in Kirkenes must be equivalent to or greater than the current capacity in Gothenburg. This would require large areas for quays, terminals and hinterland logistics, and would generate a significant number of jobs.

One can gain an indication of the scope by looking at the organisation of the ports of Oslo and Gothenburg. The Port of Oslo serves as a landlord with an administration numbering around 100 employees covering staff functions and four departments: traffic, property, technical and urban development.<sup>59</sup> The port functions as a landlord for all commercial activities at the port: terminals, railways, shipping agents, etc. Gothenburg's port is organised in a similar manner, with 120 employees in the administration.<sup>60</sup>

### **A new harbor is developed**

In this perspective, it is important to emphasize that in 2017 the Norwegian Government started the planning of a new large scaled "Barents Harbor" in Kirkenes. The new harbor, with all its complementary functions and businesses, will be developed and planned to serve both today's and the future logistics and value creation in the Barents-region.

### **Employment**

It is difficult to estimate a specific number of employees for all port-related activities because neither Oslo nor Gothenburg are directly comparable with Kirkenes. Both are also major cruise and passenger ports with almost 6 million travellers per year, and both offer a broad range of services. An economic impact report of the Port of Oslo indicates it generates 3,000 jobs.<sup>61</sup>

### **Experiences from Gothenburg**

If one looks at containers in isolation, as this would probably be the main activity in Kirkenes if it is linked to the NSR, we have comparable figures from the operation of Møller-Maersk's APM Terminals at the Port of Gothenburg, which handles the container traffic there. The terminal has 440 employees, which serve three container ships at the port daily and load/unload an average of more than 2,328 TEU. At the same time, they load/unload 14 trains with 890 TEU and 1,664 TEU arriving/departing by lorry.<sup>62</sup>

### **Experiences from Narvik**

The Port of Narvik consists of the Swedish LKAB bulk port, the central port area with piers, deep-water quay at Fagernes with intermodal facilities and Skarvenes quay, which the municipality took over from the former mining company Northland Resources. There are rail links from the quay area to southern Scandinavia and Central Europe, as well as the network to Asia and Russia. The port exports 18-20 million tonnes of cargo annually, primarily iron ore from the Swedish mines in Kiruna and Kaunisvaara. An expansion of the container area of about 45,000 m<sup>2</sup> is underway, which will

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<sup>59</sup> Oslo havn KF, annual report 2016

<sup>60</sup> Port of Gothenburg, Annual Report 2016

<sup>61</sup> Oslo havn KF on Facebook

<sup>62</sup> [www.apmterminals.com](http://www.apmterminals.com)

provide more than double the capacity the Port of Oslo currently handles.<sup>63</sup> Narvik serves on average around 15 incoming and outgoing trains per day, and the port and railway provide direct and indirect employment for around 2,100 people in the region.<sup>64</sup>

Consequently, one can easily see that with terminal operators, internal transport, cranes, a railway terminal, technical maintenance, waste management, supply services, etc., a transshipment port in Kirkenes could directly employ about 600 people. With the purchase of local services, population growth resulting from families moving to the municipality, municipal tax revenue and adaptation of public services (kindergarten and school), one is talking about a level of activity significantly larger than the mining operations in Kirkenes up to the end of 2015, measured in terms of the number of people directly employed and social impact.

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<sup>63</sup> [www.narvikhavn.no](http://www.narvikhavn.no) – *Om Narvik havn*

<sup>64</sup> Ofothanealliansen (2017) – *Ofothane, grønn transport av sjømat mot sør og dagligvarer mot nord*

## 9 THE NORTHERN SEA ROUTE – GEOPOLITICAL ASPECTS

Shorter distances compared with southern trade routes can make using the Northern Sea Route (NSR) attractive for transport between the Pacific Ocean and Atlantic Ocean region. But this will only happen if the shorter distance translates into reduced costs, and the costs are affected by factors other than distance, e.g.

- ✓ extra building and operating costs due to ice
- ✓ size limitations due to depth
- ✓ predictability due to uncertain ice situations
- ✓ administrative routines and fees

### The Suez and Panama canals

The cost assessments include risk considerations, which must be compared to alternative sailing routes. The most relevant goes via the Suez Canal. Capacity constraints resulting in waiting time to get through the canal was for a long time considered a significant disadvantage of this route or an uncertainty that supported sailing via the Arctic. However, within in a very short time, Egypt managed to expand the canal meaning the capacity was doubled from 2016. Consequently, the Arctic region's advantage disappeared. The Panama Canal has also undergone a major expansion. But sailing via the Suez Canal can involve other challenges. Piracy in the Indian Ocean was often a major problem for international shipping, but there are no pirates in the Arctic. Although the piracy continues, the scale has been significantly reduced through the establishment of various security measures. However, the entire Middle East region is characterized by unrest, and there is a fear of increasing tensions and open conflicts.

### China

It is not so difficult to imagine scenarios where international shipping is affected. This is of particular concern for China, which is also dependent on energy supplies from the region. China also perceives it is vulnerable to unrest further east in the relatively narrow Straits of Malacca. But sailing through the Arctic is not a relevant option in the event of a major international conflict between China and the United States. Sailing both in to and out of the Arctic may be controlled quite effectively by the US Navy. Nevertheless, there is little reason to doubt that China is worried about the security on the Southern Route and would like to see a supplementary route developed through the Arctic. But one may ask how much such considerations mean for commercial companies. Are they willing to bear higher costs to avoid risks on the Southern Route? Providing the prospect of problems in the south is not immediate and long-term, we do not believe so. However, the authorities may assess this differently and, for instance, be willing to contribute to facilitating shipping through the Arctic.

### Russia's interests

The most obvious geopolitical challenges and implications are linked to Russian interests and the use of the NSR, which is defined in Russian legislation as stretching from the Kara Sea in the west to the Bering Strait in the east, out to 200 nautical miles. In practice, ships wishing to sail through the Northeast Passage navigate through this area, in whole or in part. Within the defined navigation area, there are several possible routes through straits and around islands one may choose based on the ice situation and the depth requirements of the vessels. The NSR is an important part of Russia's national infrastructure, and is the shortest route from the west to the east of the country.

An important purpose of the route was the delivery of supplies to isolated coastal settlements. However, this transportation has reduced and has been replaced to a certain extent by aircraft. More importantly, operation of the maritime route is considered as a prerequisite for the extraction of

natural resources in northern Siberia. The route also has a security policy potential for Russia, enabling the transfer of marine vessels between the Pacific Ocean and the Barents Sea for part of the year. The nuclear-powered icebreaker fleet, which must be considered as an integrated part of the NSR, enables Russia to move almost anywhere in the Arctic. The NSR also constitutes a border, as the long coastline enables one to enter the Russian territory without crossing a guarded border.

### **The Law of the Sea**

It is, therefore, not unusual that Russia attaches great importance to controlling the development of shipping through the NSR. The general rule pursuant to the UN Convention on the Law of the Sea is the right to freedom of navigation outside a country's territorial waters (12 nautical miles). However, an exception to this is contained in Article 234 of the convention, which gives the coastal states the right to "adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and control of marine pollution from vessels in ice-covered areas within the limits of the exclusive economic zone (up to 200 nautical miles)". In addition, Russia invokes a historical right to administer the maritime area. There is generally little opposition internationally to Russia having the right to regulate traffic based on Article 234, but there may be different views on whether Russia does this in a non-discriminatory manner.

A related question pertaining to the Law of the Sea is the status of the many straits the shipping traffic must pass through. Are they so-called international straits through which ships may freely pass because they connect one part of the high seas with another, or are they part of the territorial waters where the coastal state has far-reaching rights? Russia believes the latter, but has also administrated the traffic through the straits in the same way as the maritime area otherwise without any major control activities. Consequently, the Russian regime is widely recognised. However, there is one important exception. The United States believes that the straits are international waters and reserves the right to sail state vessels through them without prior notice or permission from the Russia. However, this has not happened in practice.

Consequently, there is a low risk of conflicts resulting from disagreement about the legal status of the NSR. Any disagreement would probably be manifested around how Russia practices its rights and the provision it offers international users of the route. The Russian monopoly on icebreakers and Russian-flagged ships transporting of oil and gas out of the maritime area, which are adopted in Russian law, is controversial internationally. However, this disagreement primarily affects commercial users of the maritime route and their interests in it, rather than foreign states.

### **Russian security needs vs commercial considerations**

The Russian policy for the development and operation of the NSR is torn between different considerations. On the one hand, the security needs (both real and imaginary) imply control and exclusivity. There have been examples of the icebreakers being redirected to escort marine vessels, resulting in merchant vessels having to wait. Clearly, uncertainty about such decisions is negative for commercial users of the route. On the other hand, there is a desire to attract international traffic that can help to pay for infrastructure including icebreakers, as well as a desire for foreign investment in industrial projects in Russia's Arctic zone. The desire for more traffic was reflected in the improvement of various conditions for international shipping from 2009/2010, such as faster and more efficient processing of transit applications, a simplified control regime and lower fees for icebreakers. This led to an increase in transit traffic, but the numbers remained extremely low, which must have been disappointing from a Russian perspective.

### **Industrial development along the NSR**

Over the last few years, several things have shifted attention away from the transit traffic. The development of gas and oil fields on the Yamal Peninsula has gone faster than most had expected just a few years ago. The shipment of oil from Novy Port commenced in 2016, while the first shipment of LPG from Sabetta on the eastern side of the Yamal Peninsula occurred in December 2017. There are good prospects of further oil and gas developments in this area in the next few years, which means there will be a steady traffic of oil and gas tankers out of the region – year-round.

An important consequence of this is that the nuclear-powered icebreaker fleet will be almost fully occupied keeping the relevant shipping lanes open, and that the capacity to escort vessels wishing to transit the NSR will be severely limited even after three new icebreakers are delivered around 2020-2021. More icebreakers would need to be built to ensure international users a long navigation season. Although plans for this exist, there is major uncertainty about whether Russia has the economic strength to prioritize such projects.

### **Unclarified Russian attitude towards utilisation of NSR**

An internal tug-of-war is taking place in Russia about how the maritime route should be organised and operated. Should market principles and competition for services form the basis or should the administration and operation be centralised even further under a government agency? Long-term predictability is of paramount importance for foreign users, and there is currently uncertainty about what the Russian priorities will be. In a time of growing geopolitical tensions, security concerns are now even higher on the agenda. At the same time, the basic economic challenges remain the same: how to attract income and investments to the route. Foreign partners in logistics chains which include NSR should be prepared for a long-term perspective in which promises of investments are discussed in relation to Russian plans and services.<sup>65</sup>

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<sup>65</sup> Senior Research Fellow Arild Moe, Fritjof Nansen Institute, memo 8 January 2018

## 10 ARCTIC STRATEGIES ABOUT LOGISTICS

In the European part of the Arctic, Norway, Finland, Russia and the EU have all developed strategy papers clarifying their respective aspirations concerning the administration of the Arctic. Much of the focus is on the environment, climate and research, while strategies related to economic development are generally vague.

As the largest country in the Arctic region, Russia has developed a set of strategies covering the Arctic region in whole or in part. The Arctic region constitutes a significant part of Russia's territories, and is also very important from an economic and security policy perspective. These include strategies for developing the transport infrastructure on land and at sea, energy development, mineral development and socioeconomic development in selected regions within climatic zones considered as challenging for people to live in. In this perspective, as well as from an overall national development perspective, Russia wishes to invest strongly in economic development of the Arctic. In some respects, this is nothing new as industrialisation and exploitation of the enormous natural resources in Siberia and the Ural region were also important in the efforts to develop the Soviet state in the 1920s and the years ahead.

Today, the Russian economic policy in the Arctic is rendered visible through work to develop and commercialise the NSR as an international transit route, an important maritime route for domestic transport between the east and west, a destination route for cargo to and from ports along the maritime route and for export of natural resources such as petroleum, coal and other minerals.

Moreover, work is underway to develop new ports and railway lines with the aim of linking Russia and its resource-rich regions even more closely with markets in Asia, Europe and North America.

As a dominant economic superpower and trading nation, China has also to an increasing extent shown interest in development of the Arctic. So far much of this has been linked to research, but China has also invested heavily in Russian industrial and logistics projects in Western Siberia and in the Arctic region of European Russia. This is part of China's efforts to secure the country's enormous need for stable imports of energy and minerals, while it is also part of the efforts to improve the trade routes to and from China – the so-called *Belt and Road Initiative*.<sup>66</sup> However, this is not only aimed at the maritime sector. It also has a strong focus on the export of goods by rail and other means of transportation from China to Europe without using the sea route.

China has to date not developed an overall Arctic strategy, meaning the Chinese government's attitude towards the Arctic may only be read in individual official statements and, as such, appears fragmented.<sup>67</sup>

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<sup>66</sup> Previously called *One Belt One Road* (OBOR), the initiative is plural with three main routes by land and sea linking China and Europe, and China now uses the term *Belt and Road*.

<sup>67</sup> Arthur Guschin, guest researcher Fudan University, Shanghai, e-mail 29 October 2017



Figure 7 – The new Silk Road, Belt and Road



Design: Tristan Kenderdine, Futurerisk